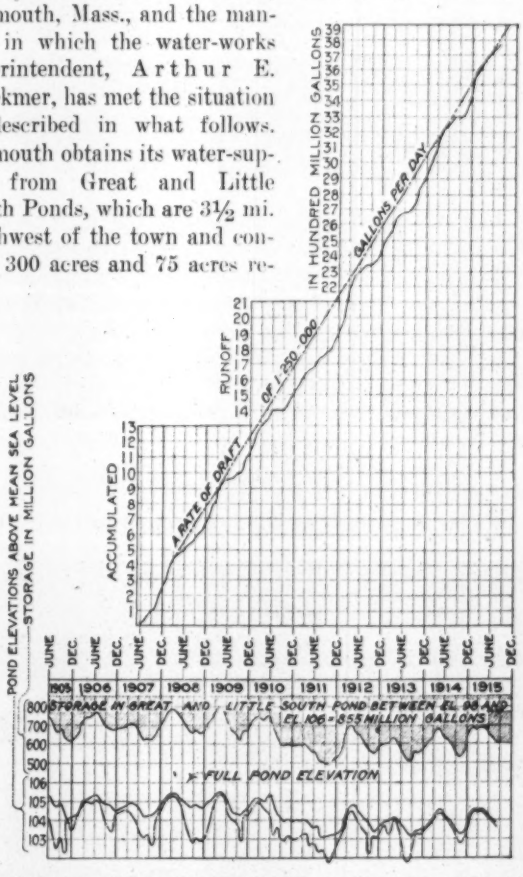
Warning the Public Against Overdrawing a Reservoir

To convince the lay public of a small city or town that at the prevailing rate of water consumption the city supply is being slowly but surely depleted, while there is still plenty of water in sight, is not an easy task. Yet it is obviously the duty of an efficient water-works manager to warn against a possible water shortage and to present his arguments in such form that they will be readily understood. Such a condition of affairs exists in Plymouth, Mass., and the manner in which the water-works superintendent, Arthur E. Blackmer, has met the situation is described in what follows. Plymouth obtains its water-supply from Great and Little South Ponds, which are 3½ mi. southwest of the town and contain 300 acres and 75 acres respectively. These two ponds are about 500 ft. apart and are connected by an open channel, consisting of a 12x5-ft. concrete flume about 150 ft. long and 350 ft. of ditch.


ACCUMULATED RUNOFF IN HUNDRED MILLION GALLONS
GALLONS PER DAY
RATE OF DRAFT OF 1,250,000
POND ELEVATIONS ABOVE MEAN SEA LEVEL
STORAGE IN MILLION GALLONS
1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915
STORAGE IN GREAT AND LITTLE SOUTH POND BETWEEN EL. 98 AND EL. 106 = 855 MILLION GALLONS
FULL POND ELEVATION

DIAGRAMS SHOWING CONDITION OF WATER-SUPPLY OF PLYMOUTH, MASS.

Upper—Accumulated run-off diagram, showing permanent depletion of water-supply. Center—Storage depletion diagram, showing an overdraft on available water-supply. Lower—Diagram showing heights of water in Great and Little South Ponds, Plymouth, Mass., water-works

These ponds have no streams running into them and apparently are fed from springs, but when they reach elevation 106 ft. above mean low water of the sea they waste over a stone sill, the elevation of which was established by the courts when these ponds were first taken as a water-supply. The gatehouse is situated on the north shore of Little South Pond and water is taken through 100 ft. of 30-in. pipe which branches into an 18- and a 16-in. pipe.

About one-half the total consumption comes by gravity through the 16-in. pipe line to a distributing reservoir in the center of the town and the remainder flows by gravity from the pond through the 18-in. pipe line about 7,500 ft. to a pumping station, from which it is pumped to a high-service distributing reservoir in the rear of the pumping station at an elevation of 165 ft.

On the 16-in. gravity line is a venturi meter with a chart recorder, and the quantity of water pumped is measured by plunger displacement. (A venturi meter is now being installed to check the plunger-displacement.)

A careful survey of Great and Little South Ponds has been made, with soundings sufficient to locate the 5- and 10-ft. contours of the bottom. These data make possible the calculation of a table of storage volumes (Table 1).

TABLE 1. VOLUME IN GREAT SOUTH AND LITTLE SOUTH PONDS FOR EACH FOOT IN DEPTH

	Elevation	Great So. Pond 1,000,000 Gal.	Little So. Pond 1,000,000 Gal.
Full pond	106		
	105	97.7	21.7
	104	94.2	21.3
	103	91.3	20.6
	102	88.5	20.0
	101	85.6	19.4
	100	82.9	18.8
	99	80.1	18.1
	98	77.4	17.4
	97	75.0	16.7
	96	72.6	16.0
		845.3	190.0

A gage is set in the concrete culvert at Great South Pond and a record is kept of the elevation of Great and Little South Ponds. The lower diagram in the accompanying figure shows pond elevations, the elevation of Little South Pond being in dotted lines and of Great South Pond in full lines. The middle curve is a storage-depletion diagram and is constructed as follows: Between grade 106, or full pond, and grade 98, which is 3 ft. above the bottom of the 30-in. intake pipe, is a storage volume of 855,000,000 gal. in Great and Little South Ponds. From the diagram of pond heights and the table of storage volumes, it is a simple matter to compute the available storage at the end of each month, thus furnishing the data for drawing the storage-depletion curve.

The accompanying runoff curve is constructed as follows: The total quantity of water withdrawn each month from the two water-supply ponds, excluding seepage and evaporation, passes through the venturi meter on the gravity system or through the pumps. The sum of these two quantities is the total draft from the watershed, for a glance at the diagram of pond heights shows that no water has been wasted over the spillway during the period covered by this record.

The total consumption for each month is added algebraically to the monthly change in the storage volume of the ponds, and the sum of these two quantities is called the watershed yield for that month.

The curve of accumulated runoff is the sum of these monthly quantities since records have been kept. On this runoff diagram a dotted line has been drawn for a uniform draft 1,250,000 gal. per day. The average daily draft from the watershed (equivalent to the daily average consumption) is shown in Table 2.

TABLE 2. AVERAGE YEARLY CONSUMPTION OF WATER, PLYMOUTH, MASS.

Year	Av. Daily Consumption, Gal.
1908	1,220,000
1909	1,267,000
1910	1,251,000
1911	1,310,000
1912	1,371,000
1913	1,307,000
1914	1,383,000

Mr. Blackmer concludes from these data that the safe daily yield of the watershed does not exceed 1,250,000 gal. per day, and with the help of these charts he is endeavoring to bring this fact home to the public.

Brick and Concrete Hillside Pavements in Birmingham

The newer residence section of the City of Birmingham, Ala., is in a very hilly district where street grades are of necessity high. In order to facilitate the movement of horse-drawn traffic, which found it nearly impossible to use some of the streets, especially in wet or icy weather, the city engineering department has put in a number of short stretches of special paving ridged to guarantee a horse's foothold. Two types, one of brick and one of concrete, have been used.

The details of the concrete pavement are shown in Fig. 2. The street is laid in three sections between curbs—a central asphaltic, or cement concrete, smooth section for motor traffic, a narrow corrugated, or stepped, concrete section on the right-hand side going up for ascending horse-drawn vehicles, and a similar wide corrugated section on the left for descending horse-drawn vehicles, the whole street being laid on a solid concrete base. The uphill section is left narrow because vehicles will hardly try to pass on a stiff upgrade. The steps are formed between transverse iron bars, 1½ in. by $\frac{3}{16}$ in. in section, the tread of the step being screeded from the top of a lower bar to ½ in. below the top of the next higher bar. The bars are held in place by longitudinal ¼-in. rods passing through and wired to each bar.

The base concrete, which is 5½ in. thick at the steps and 4 in. at the center, is a 1:3:6 mixture using local slag as coarse aggregate. The finished coat to the step is a 1:1½ concrete, using a crushed stone graded from $\frac{1}{16}$ in. to ½ in. as aggregate.

This pavement has been laid on four separate stretches of street, all of short length, on grades varying from 10 to 22%. It has been down about 18 months and has shown excellent wear, although of course the traffic over it is not great. It is found that dirt tends to collect in the corners against the exposed bars, not enough to defeat the purpose of the steps, but sufficient to form a cushion against excessive wear at those points. The cost of the pavement was about $1.75 per cu.yd., including about 8 in. of grading.

The brick pavement is shown in the view in Fig. 1. This is laid in a concrete base with grouted joints and differs from an ordinary grouted brick pavement only in the type of brick. These are the regulation 3½ in. width and 9 in. length but are formed so as to be 3½ in. deep at one end and 4 in. deep at the other, so that when laid with bottoms level there is a ½-in. lift at each brick, which is continuous across the street from curb to curb. The bricks were burnt at Birmingham, only a slight rearrangement of the regular dies being required.

Three streets have been paved with this brick on grades from 10 to 18%. The cost of the pavement was about $2.10 per sq.yd., but this price should be reduced when once the dies are prepared.

Both types of pavement have proved much easier for horse-drawn traffic, which can now go where hitherto it has been impossible. The roughness is hardly per-

FIG. 1. HILLSIDE BRICK PAVEMENT AT BIRMINGHAM, ALA.

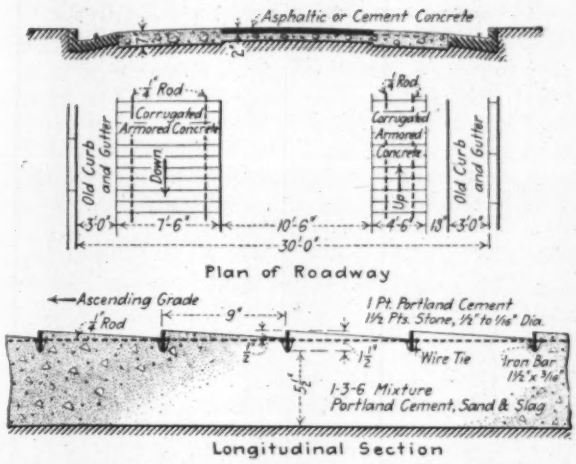


FIG. 2. CONCRETE STEPPED PAVEMENT FOR HILLSIDE STREETS, BIRMINGHAM, ALA.

ceptible to an occupant of a motor vehicle, and such traffic has not been deterred from using the streets.

These pavements were devised and placed under the direction of J. D. Webb, Assistant City Engineer in Charge of Construction. Julian Kendrick is City Engineer of Birmingham.

Contracts for Land Drainage

The following interesting suggestions for improvements in the letting of contracts for land-drainage work are from a report on "Drainage in the Southern Section of Michigan," by A. D. Morehouse, Drainage Engineer, Department of Agriculture, Washington, D. C.:

Advertising and Letting Contracts

In all drainage work amounting to over $5,000 or $10,000 the law should stipulate that publication of the "notice of letting" and of the receiving of bids for the work be made for not less than three or four weeks in one or more engineering or contracting journals of general circulation, in addition to the county papers. This would give the widest possible circulation of the notice among contractors and thus secure the best bids. It would obviate the necessity of personally notifying contractors, as is attempted at present by a number of drain commissioners. It would also prevent favoritism being shown in such notification.

Should the farmer wish to bid, which now seems rarely to be the case, he should be compelled to enter into fair and open competition with responsible bidders and to take his chances with them. In order to secure the lowest bids the work should usually be let as an entirety or in such large sections that it will pay responsible contractors to attend the lettings and bid on the work. The best results are often secured by receiving sealed bids. The method of letting drainage work should be left to the decision of the drainage commissioner. Even though open bids are received, sealed bids should be accepted and placed, unopened, in view of the other bidders, to be opened after the lowest open bid has been received. The contract should then be let to the lowest responsible bidder.

A practice much to be condemned is that of changing the specifications of tile or open ditchwork at the time of the letting. This is decidedly unfair to the contractors who have attended in good faith and who by the change may be prevented from bidding. It is also a dangerous procedure on account of the liability of doing, on the impulse of the moment, that which may be eminently unwise from an engineering or economical standpoint.

A case in point is that of the changing of a ditch from a specified bottom width of 10 ft. to a bottom width of 4 ft. This change, besides being presumably unwarranted from an engineering standpoint, prevented a dredge contractor who had secured the contract for the adjacent short section from bidding successfully on the section in question, to which he was practically entitled and which he would have secured had the size not been changed.

Postponing the Award of Contract

Another questionable method sometimes used is for the commissioner, after receiving a fair low bid, to offer such bidder a still lower price and, upon his refusal, to adjourn the "letting" in the expectation of receiving from him a lower bid. This procedure is occasionally even repeated the second time.

The other responsible bidders have by this time grown cold in the matter and do not attend. The original low bidder (who in one case was about completing a contiguous job) is then by force of circumstances usually obliged to take the job at a still greater reduction in price than was offered him at the second "letting." Such experiences are not conducive to securing bids from responsible contractors. The law should provide against delaying the award or changing the specifications.

Practically all bids requested are for the price per rod of ditch, so that in comparatively few cases could even the approximate yardage be obtained. In this class of work it is far more logical, and a nearly universal custom, to make all estimates and computations on a basis of cubic yards. It is very difficult to make any changes in dimensions of the ditch or to provide for any extra work under the price-per-rod system; and the yardage not being known (even approximately) the contractors find themselves largely in the dark in their bidding. This often causes much loss to the contractor, or much trouble to the drain commissioner in forcing an irresponsible contractor to live up to his contract.

The Steam Boiler Code adopted by the American Society of Mechanical Engineers is to be pressed for general adoption in the legislatures of the several states by the American Uniform Boiler Law Society, an organization formed of representatives of the principal trade and technical organizations that coöperated with the American Society of Mechanical Engineers in the drafting of the code. The code has already been accepted and put in force by the officials in charge of steam-boiler inspection in the states of Ohio and Indiana and the cities of Detroit and Chicago, while the state authorities of Pennsylvania, Wisconsin and California have signified their acceptance of the code and will put it in force later. This winter bills for the adoption of the code are to be introduced in the legislatures of Georgia, Kentucky, Louisiana, Massachusetts, New York, New Jersey, Rhode Island, South Carolina and Virginia. The committee of the Uniform Boiler Law Society promoting the legal adoption of the A. S. M. E. code has as its chairman Thomas E. Durban, of Erie, Penn. Among the other members are E. R. Fish, of the American Boiler Manufacturers Association; I. Harter, Jr., representing the water-tube boiler manufacturers; John H. Wynne, representing the locomotive manufacturers; Walter Plehn, representing the steam-shovel manufacturers, and H. M. Covell, representing the hoisting-engine manufacturers.

Grandstand for the Chicago Automobile Speedway

The Maywood automobile speedway near Chicago, which was described in *Engineering News* of Sept. 9, 1915, page 488, provides seating accommodations for about 100,000 persons in the grandstand and bleachers. These structures are of wood, but the grandstand has a steel roof on steel columns, which serve also to support the deck and seats. Both structures are designed to carry safely a load of 200 lb. per sq.ft., with allowance for the movements of crowds.

The grandstand is 2,250 ft. long and seats 60,000 persons. A general view of it is given in Fig. 1. Fig. 2 shows the typical character of the construction (but without the roof). It has six-post bents spaced 12 ft. c. to c., with longitudinal bracing in alternate panels both front and back. The posts, 8x12 in., carry 8x16-in. stringers. On these are laid 2x14-in. joists, arranged in pairs and inclined about 1 on 2. Upon these are the tiers of seats, with 30-in. tread and 13-in. rise, the width being sufficient to allow chair seats (with backs) being fastened to them. At the gangways are intermediate steps to form convenient stairways.

The architects' original design provided for a roof having timber trusses supported on three lines of columns. In view of the time which would have been required to build these trusses the design was changed to a steel roof, but still with three lines of columns. The front row of posts being objectionable, the contractor's engineers prepared a design for a two-column roof, with trusses extending as cantilevers over the front part of the grandstand. This was approved and the roof was built according to this design, as illustrated in Figs. 1 and 3.

The details are shown in Figs. 4 and 5. Each column is composed of an I-beam and two channels, with batter plates over the flanges of the latter. The trusses are built up of angles. The rear posts are braced by diag-

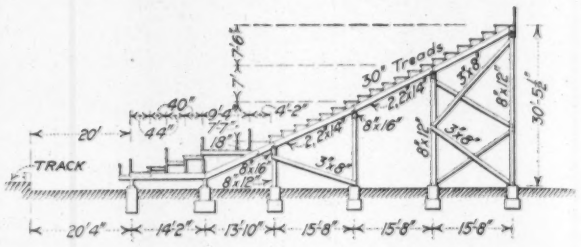


FIG. 2. TYPICAL SECTION OF GRANDSTAND

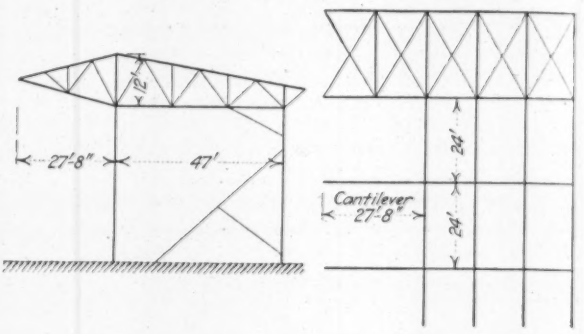


FIG. 3. DIAGRAM OF STEEL ROOF FOR GRANDSTAND

onal members (Fig. 3), and longitudinal diagonal bracing is provided in alternate panels. The steel bents are spaced 24 ft. c. to c., and their columns form part of the alternate bents of the structure supporting the deck and seats of the grandstand. The corresponding timber posts

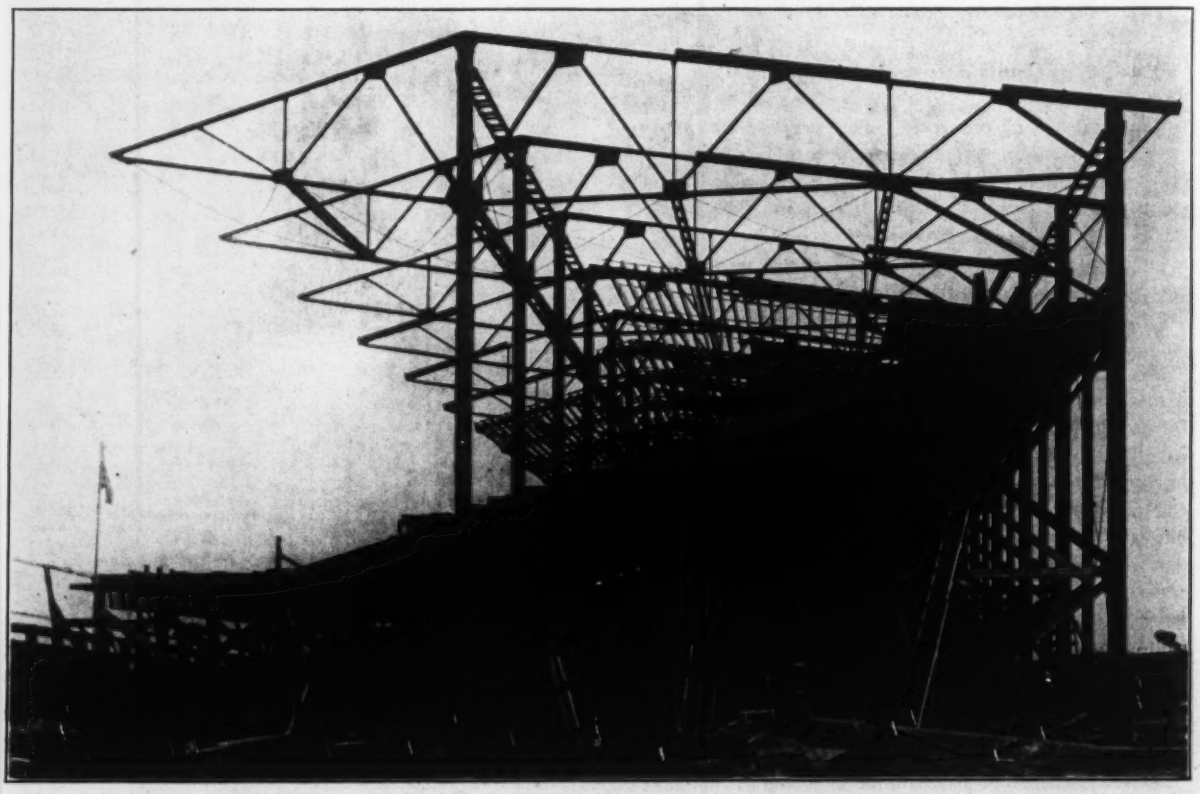


FIG. 1. STEEL ROOF FOR TIMBER GRANDSTAND AT THE MAYWOOD AUTOMOBILE SPEEDWAY

are omitted in these bents, the floor joists being carried by angle brackets on the posts, as shown.

The trusses are 74 ft. 8 in. long and 12 ft. deep, cantilevered 27 ft. 8 in. beyond the inner columns. Longitudinal struts are placed between the columns. These are pairs of channels with top and bottom batten plates. Diagonal rods for wind bracing are placed in the plane of the top chords of the trusses. The timber joists of the roof are laid across the trusses and secured to angle brackets on the top chords. They are covered with plank sheathing and a felt and composition roofing.

The roof as built was designed by the Shank Co., of Chicago, the general contractor for the Speedway. Frederick Grim was Chief Engineer and Alfred H. Marshall, Principal Assistant Engineer. The steel was fabricated by the Hansell-Elcock Co., of Chicago. It was erected by the general contractor, a stiff-leg derrick with a 50-ft. boom being used for this work. Each column was handled complete, but the trusses were erected in two sections.

A 20-ft. open space or safety zone is left between the grandstand and the track. A heavy guard timber on posts is built along the edge of the track, and there is also a high screen of netting (shown at the left in Fig. 1) to catch tires which may be thrown from the wheels of the cars in races.

When this track was opened the fastest time ever made on a continuous track was made, but this speed was afterward bettered in the new motor speedway at Sheepshead Bay in the Borough of Brooklyn, New York City.

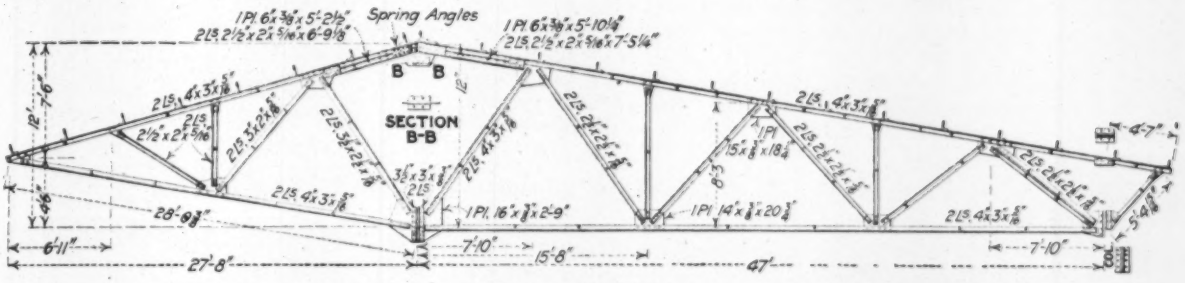


FIG. 4. CANTILEVER TRUSS FOR ROOF OF GRANDSTAND OF MAYWOOD MOTOR SPEEDWAY

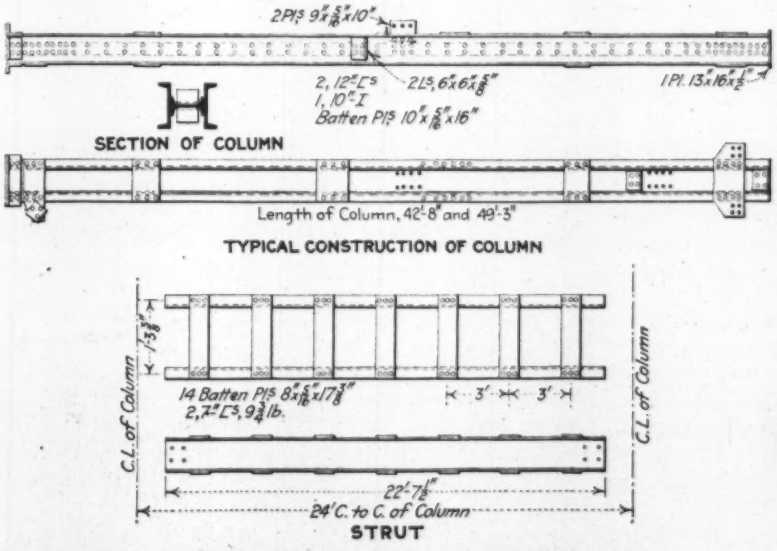


FIG. 5. COLUMNS AND STRUTS FOR ROOF OF GRANDSTAND

Hints on the Use of the Tremie

In the October *Proceedings* of the American Society of Civil Engineers, Clement E. Chase, of Pittsburgh, Penn., in an article on the Cherry St. Bridge at Toledo, Ohio, makes some valuable suggestions as to the use of the tremie in depositing concrete.

Tremie work, though practiced for years, is far from being standardized, and as it is on the details of the construction and the handling of the tube that success depends, the methods used at Cherry St. may be of interest.

The tremie pipe consisted of flanged sections of 12-in. spiral, riveted pipe, which were bolted together to make up the various lengths required. The top section was short and was riveted to a pyramidal hopper of ¼-in. sheet steel, stiffened with angles and having a capacity of about 1 cu.yd. The edges of this hopper rested on a timber frame, suspended from the derrick by slings at the four corners. The discharge pipe from the floating mixer was self-supporting, and was simply held in place over the hopper by lines, in such a way that it's weight did not have to be lifted when the tube was raised. A signalman, usually accompanied by the inspector, "rode" the hopper and gave directions to the hoisting engineman.

Three things which must be most guarded against in tremie work, under conditions such as those at Toledo, are, first, the "plugging" of the pipe; second, the loss of the charge; and third, allowing the concrete to drop through water as it leaves the pipe. The first causes serious delay, disturbance of the concrete already placed, and danger to derrick and tremie from efforts to start the concrete flowing, and, usually, in the end, loss of the charge, thus making it necessary to refill the tremie. It can be avoided by using a quite wet mix, with small aggregate where possible, and by having the pipe hoisted enough to start the charge moving just as the hopper starts to fill, instead of after it is full. There does not seem to be any advantage in having a pipe larger than that used on this work.

The second trouble causes serious washing of the last of the concrete in the pipe, for, as the column of concrete nears the bottom, the water rushes up through it to fill the tube. Also, refilling the tremie always causes more or less washing out of the cement. Loss of charge can only be avoided by good team work between the signalman and derrickman. The lowering of the pipe to stop the flow must be started in time, so that the pipe will be completely sealed, at least when the concrete has lowered in the tube to about the water level. The pipe should be lowered gently so as not to disturb the concrete already deposited. To reduce washing in filling the tremie, a cement sack, loosely filled with straw, will act as a plunger and force the water before it as the weight of the concrete forces it through the tube. The sack will usually float to the surface after passing through the pipe.

The third trouble will cause loss of cement from the charge and churning of the deposited concrete. The pipe must be "picked," or lifted, just enough to start the flow, which will rarely bring the lower end out of the soft concrete previously deposited. A concrete with a small aggregate is handled much more easily than one with the larger sized stone.

Engineering Literature

Sewage Disposal Up To Date

REVIEWED BY JOHN H. GREGORY*

AMERICAN SEWERAGE PRACTICE; Vol. III, Disposal of Sewage—By Leonard Metcalf and Harrison P. Eddy. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiii + 851; 230 illustrations. $6, net.

The final volume of this notable work on American sewerage practice is devoted to the disposal of sewage and contains a fund of valuable information on this most important branch of the subject. Together with the preceding volumes, which treat respectively of the design and construction of sewers, these three books give the most complete and uptodate information on the subject of American sewerage practice.

In Chapter I, which is mainly historical, the authors trace the developments in the art of sewage treatment from the earliest steps taken in England, about the middle of the last century, down to the present time, and discuss briefly the successive steps taken in developing the art not only in England, but also in the United States and Germany.

The meaning of chemical analyses is discussed at more or less length in Chapter II, and, as the authors state, the effort is made in this chapter to explain, for the benefit of engineers, lawyers and others who lack a knowledge of chemistry adequate to a full understanding of the results of these analyses, the general method of analysis, the meaning of the technical terms used and the interpretation of the results obtained.

Two chapters, 70 pages, are devoted to bacteria and their relation to the problem of sewage disposal, and to plankton. The authors present an interesting discussion of these two subjects and include a brief but especially good discussion of typhoid fever, with just enough tables and statistics for the reader to get a good idea of the close relation between typhoid fever and sewage disposal.

The composition of sewage is taken up in Chapter V. In addition to the detail discussion of the subject the authors have assembled here numerous tables giving the analysis of the sewage of various cities in the United States as well as in England and on the continent of Europe.

One chapter is devoted to a brief exposition of the theories of sewage disposal, in which the authors discuss the disposal of sewage by dilution and the treatment of sewage by grit chambers, screens, plain sedimentation, septic tanks, Travis hydrolytic tanks, Imhoff tanks, tanks with colloiders, chemical precipitation, activated sludge, contact beds, trickling filters, sand filters, broad irrigation and disinfection. This chapter, in effect, serves as a well-prepared introduction to the subsequent chapters which discuss more at length and in greater detail the several methods of treatment just mentioned.

In the chapter on the disposal of sewage by dilution, various phases of the question are considered, as the influence of suspended matter, the aëration of sewage-laden waters, the self-purification of natural waters, the conditions for successful disposal by dilution, the basic information necessary for planning dilution projects, tides, and the effect of the character of the water receiving sewage. Throughout the discussion numerous examples are cited to illustrate the principles involved.

To the subject of grit chambers 22 pages are devoted. Descriptions are given of different types of grit chambers in use in this country and abroad. The chapter well illustrates the wide diversity of views held by engineers at the present time on the design of grit chambers, due perhaps in a large measure to the lack of accurate information on the results of operating such devices.

Chapter IX treats of racks, cages and screens. Descriptions are given of numerous installations. While the reader can gain much by a study of this chapter its value would be increased if the relative advantages and disadvantages of the different types were discussed more at length, and if more space was given to the minor details of design and construction which play such an important part in the convenience of operation.

In the chapter on sedimentation, straining and aëration the authors touch briefly on the theory of sedimentation and then take up more in detail the discussion of horizontal- and vertical-flow tanks, the design of such tanks and the action of strainers or roughing filters. Aëration and activated sludge are also discussed, and a résumé of the experiments made at Lawrence, Mass., Manchester, England, and by the Illinois State Water Survey is given. The Milwaukee experiments are but briefly referred to. In a later edition of the book a much more extended discussion of activated sludge will be welcomed.

Chapter XI deals with tanks for sludge digestion, and under this head the authors take up successively the septic tank, the Travis tank, the Imhoff tank and the Lethbridge tank, the latter a type of tank somewhat similar to the Imhoff tank. The treatment of the Imhoff tank is especially good, but more space could to advantage be given to a discussion of the details of Imhoff tanks. Convenience of operation is one of the prime requisites for success in sewage-treatment works, and the necessity for well-designed details cannot be too strongly emphasized.

To the chapter on chemical precipitation the authors devote 19 pages, but additional information on the subject is found in some of the other chapters of the book. The chemicals ordinarily used are first described, and then the preparation of the chemicals and their mixing with the sewage are taken up. Data are given on the volume of sludge produced. The chapter ends with some practical suggestions on the design of precipitation tanks.

The handling and disposal of sludge are well treated in Chapter XIII. After describing the character and composition of sludge, the authors discuss the removal of sludge from tanks, sludge pumping and pressing, the drying of sludge by centrifugal machines and on drying beds, and the disposal of sludge at sea, in lagoons and trenches and by burning.

*Consulting Engineer and Sanitary Expert, 170 Broadway, New York City.

Contact beds are next taken up, and various phases of the construction and operation of such beds are discussed. The nature and depth of material used in building contact beds are described and data are given on the rate of operation, on multiple contact and on the maturing and loss of capacity of the beds. Dibdin slate beds are also briefly referred to. The chapter closes with data on the cost of constructing and operating contact beds.

The longest and most interesting chapter in the book is that on trickling filters. After treating of the character, size and depth of filtering material, the authors devote considerable space to a detailed discussion of the application of sewage to the filter. Under-drainage, ventilation, construction and operation are among the other subjects taken up.

A good discussion of intermittent sand filters will be found in Chapter XVI. After describing the materials used in, and the construction of, such filters some especially valuable information is given on the operation of sewage filter beds and on their maintenance in winter. The chapter closes with figures on the cost of construction and operation.

In the chapter on irrigation and the agricultural utilization of sewage and sludge, the use of sludge as a fertilizer is first taken up, following which are descriptions of the experiences obtained with the operation of sewage farms in England, Germany, France and the United States.

Automatic apparatus for dosing intermittent sand filters, contact beds and trickling filters are illustrated and described in Chapter XVIII, and special forms of dosing tanks used for dosing trickling filters are briefly referred to.

Chapter XIX deals with the disinfection of sewage and sewage effluents, and while chemicals other than hypochlorite of lime and liquid chlorine are referred to, the authors' discussion relates largely to disinfection by means of these two. After describing the several chemicals used, there then follows a general and detailed discussion of the subject of disinfection with frequent references to the results secured by the application of disinfectants, as shown by experimental investigations and at certain works where careful operation records have been kept.

The last chapter in the book is devoted to the disposal of sewage from residences and institutions. The arrangement, construction and operation of several small works are described. A table of considerable interest has been included at the end of the chapter, in which the per capita sewage flow from nearly twenty different institutions is given. The appendix contains a number of convenient conversion tables.

While the idea might possibly be gained from the title of the book that the subject matter was confined to the disposal of sewage from the standpoint of American practice only, such is not the case, and the reader will find much valuable information on sewage disposal as practiced in Europe, especially in England.

The book is well printed, is uniform in appearance with the two preceding volumes and is well illustrated with many carefully prepared drawings and halftones, although the illustrations relatively are not as numerous as in the earlier volumes.

[Vols. I and II of this work were reviewed by Mr. Gregory in *Engineering News* of Feb. 11 and Mar. 18, 1915, pages 260 and 532.—Editor.]

Truly Practical Mathematics

REVIEWED BY LEON S. MOISSEIFF*

A TEXTBOOK ON PRACTICAL MATHEMATICS FOR ADVANCED TECHNICAL STUDENTS—By H. Leslie Mann, Lecturer in Advanced Practical Mathematics, The Woolwich Polytechnic. New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. xi + 487; 149 illustrations. $2.10, net.

The practicing engineer frequently meets a ready formula which he would like to deduce and check to satisfy himself of the validity of the assumptions on which the formula has been built and of the correctness of its derivation. In his scientific studies the engineer also encounters many an equation he would like to establish or to solve, and especially in analyzing the conditions of new problems he requires the concentration and definiteness of the mathematical symbol. He then is thrown back on his old mathematical knowledge and not infrequently finds it rusty, and himself awkward in handling the old tools. In such times the engineer will be grateful to find at hand a work which in a short and concise manner presents methods of treating problems similar to his. Mr. Mann's "Practical Mathematics" is such a book. While the author calls it a textbook, it is by no means what its name implies. It does not teach mathematics; it rather presumes a knowledge of it. It does better; it reminds one of what he has forgotten. It consists practically of methods to solve problems stated in as few words as possible.

The book is divided into three sections, covering 25 chapters. These sections are algebra and trigonometry, the differential and integral calculus, and their application to concrete examples. The algebraic section treats of the means of handling equations and fractions for purposes of integration, of trigonometric functions and of complete quantities. The calculus section treats of the method of series and the integration of various expressions. The third section, comprising about 250 pages, or more than half of the book, deals with the application of mathematics to geometry, mechanics and physics. Each chapter concludes with a number of examples for exercise, and an appendix gives the answers.

The book has a thoroughly practical aspect, and it is evident that an experienced and practical mind has written it. The reader, or rather the user, of the book will be grateful to the author for its production.

PURCHASING: Its Economic Aspects and Proper Methods—By H. B. Twyford, Otis Elevator Co. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xvi + 236; 121 illustrations. $3, net.

The chapters in Mr. Twyford's book which deal broadly with purchasing are most interesting. Of special value should be the description, including forms, of the mechanical process of buying goods—that is, placing the requisition and order, and methods of following up shipments. In the last section the author discusses in four chapters purchasing for railway construction, manufacturing and construction companies, for construction and operation in widely separated localities, and purchasing for a small manufacturing establishment.

Of peculiar interest is Mr. Twyford's statement that personal contact between buyer and seller is not the potent factor it once was. He aptly likens this condition to the dying out of personal combat in war. If the author's conception of scientific purchasing ever becomes general, then a mail order will give as satisfactory a result as an expensive (both in time and money) personal transaction.

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Purchasing will be greatly simplified when the selling price is recognized to be cost plus a reasonable profit—10% according to this book.

River Control and Improvement

REVIEWED BY W. H. BIXBY*

THE REGULATION OF RIVERS—By J. L. Van Ornum, M. Am. Soc. C. E., Professor of Civil Engineering, Washington University, and Consulting Civil Engineer. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. x + 393; 99 illustrations. $4, net.

This book covers a sphere of work about which there are but few recognized textbooks by American writers, and which up to the present time has been directed and executed principally by the United States Army Corps of Engineers and their many civil-engineer assistants. The need of a good comprehensive textbook on this topic has long been recognized by the engineering profession. The author of this book has the great advantage, so seldom realized, of having combined actual field practice in the government service on some of our largest rivers with subsequent careful study as a professor of civil engineering in one of our best universities located near large rivers and within easy reach of officials still engaged in such work. Accordingly his offering to the engineering profession represents an uptodate presentation of his subject and the best and latest methods.

The book deals with the great need of full utilization of our inland-navigation resources, their commercial considerations, the general phenomena of rivers—including especially their water flow—river surveys, river improvement in general, the principles and best methods of river regulation and of current control, dredging, bank protection, levees, etc.

The author's discussion of the commercial considerations affecting waterways and railways is remarkably valuable for its broad point of view. It well shows why railroad development has recently far exceeded waterway development in the United States; at the same time it points out how valuable to the country would be a fuller and better-standardized waterway development well provided with efficient terminals and with connections combining joint use of both boats and railways, all based upon sound economic principles of coördination and coöperation instead of upon commercial warfare between railways and waterways.

Under the head of "General Phenomena" the author's exposition of the complex question of the effect of forests and reservoirs upon navigation is one of the best résumés yet published, showing how completely any engineering decision on this subject must be dependent upon the individual surrounding circumstances.

In other chapters his discussion of the principles of river regulation by dredging, channel contraction, bank protection and levees is equally uptodate and shows how necessary it is that such work should be carried on under a carefully studied project directed towards a final accomplishment of a complete protection of the channel and banks by gradual steps each based upon the most immediate needs and upon true economical considerations. His discussion is supplemented by brief descriptions of some of the United States, European and Asiatic rivers, and of the methods by which they have been controlled and improved, all largely based upon published reports of the Chief of Engineers, United States Army, of the International Association of Navigation Congresses (whose last meeting was at Philadelphia in 1912) and of foreign engineers—to whom he gives due credit—checked up by personal experience and in some cases by personal inspections.

The question of the relative disadvantages and advantages of cutoffs is not discussed as fully as might seem desirable and possible, but is limited to the statements of a few facts illustrating the limitations of their use.

The book, as shown by its title, is restricted to a consideration of the "regulation of rivers," so it does not include any description of the dams, locks and side canals which belong to river canalization; but pertinent to its subject, it contains a due amount of description and illustration of bank-heads, spur-dikes, submerged sills, training walls, bank revetments, hydraulic dredges and levees.

The modern hydraulic engineer has begun to realize the usefulness of small-scale models by which in the laboratory he can test his theories and secure a definite and reliable indication of what his proposed constructions will probably effect when actually constructed in the waterway itself. Several pages of this book are devoted to showing how such models have already been employed in England, France and Germany (where they have been used far more extensively than in the United States), how useful they may be and how they should be constructed in order to give the most useful and most reliable indications of probable results in the full-sized waterway.

The book, with its excellent index, should be of great use and value to the modern hydraulic engineer when called upon to undertake work of river control and improvement.

SURVEYING AND FIELD WORK: A Practical Textbook on Surveying, Leveling and Setting-Out, Intended for the Use of Students in Technical Schools and Colleges and as a Work of Reference for Surveyors, Engineers and Architects—By James Williamson, Assoc. M. Inst. C. E. [The Glasgow Textbooks.] New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xxii + 363; 271 illustrations. $3, net.

In general, surveying textbooks of British origin are not of particular value to American students; not merely because we have a number of excellent American texts, but because English surveying instruments, methods and terms generally strike the American engineer as somewhat antiquated. This book, however, has at least one great advantage—it is written in clear and concise language. It is an excellent elementary text on surveying, notwithstanding its English character, and should find a welcome place in engineering libraries.

A BIBLIOGRAPHY OF MUNICIPAL GOVERNMENT IN THE UNITED STATES—By William Bennett Munro, Professor of Municipal Government. Harvard University. Cambridge, Mass.: Harvard University Press. Cloth; 6x9 in.; pp. xiii + 472. $2.50, net.

A useful bibliography, selective rather than inclusive, with very brief critical notes where thought necessary, is here presented in dignified form. Half the references are to publications not more than five years old, and more than three-fourths to books and articles of a date later than 1905. The main divisions are: General Works; Political Machinery and Direct Legislation; Municipal Organization; City Planning and Public Improvements; Utilities, Sanitation and Public Health;

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Safety; Education and General Betterment; Finance. Under each of these heads are various subheads, the total of subheads being 76. An index, subject and author combined, adds materially to the value of the book.

Internal-Combustion Engines

REVIEWED BY H. E. LONGWELL*

INTERNAL COMBUSTION ENGINES, Theory and Design: A Textbook on Gas and Oil Engines for Engineers and Students in Engineering—By Robert L. Streeter, Assistant Professor of Mechanical Engineering, Russell Sage Foundation, Rensselaer Polytechnic Institute. New York and London: McGraw-Hill Book Co., Inc. Cloth; 7x10 in.; pp. xi + 418; 240 text illustrations and drawings. $4, net.

This is a conventional textbook on internal-combustion engines—not appreciably better or worse than the average of its predecessors; and unless history fails to repeat itself, it probably will not suffer seriously by comparison with its inevitable successors.

The opening chapter is painfully elementary. The author states that it is written for the benefit of the many students who have a working knowledge of mechanics and thermodynamics, but who are not at all familiar with the details of gas engines, or the names and functions of the various parts.

It requires a lively imagination to picture an individual presenting himself for instruction in gas-engine design who does not know that "the base plate on which the engine is fixed and the cylinder bolted is of cast-iron usually," or that the valves "admit fresh gas into the cylinder at the proper time, and allow the exhaust gases to escape"; or that "the force on the reciprocating gas-engine piston is transmitted to the revolving crank-shaft through a connecting-rod and crank." If there be such a one, it is safe to say that mechanical engineering is far from being his real vocation.

Much of the information in this introductory chapter is rather "sketchy" in character, especially the part dealing with the advantages of compression. For example, the fact that "the particles of gas are pressed more firmly together" is not a very scientific reason why the combustion temperature should be higher than if the gas had not been compressed.

It is strange that writers avoid the simple, common-sense reason why compression is advantageous; that is, that in an engine working on the Otto cycle a higher compression means a smaller clearance volume and consequently a more complete expansion of the exploded charge. The efficiency is a function of the ratio of compression for no other reason that that the ratio of compression is incidentally the same as the ratio of expansion.

The method of calculating the cylinder dimensions is interesting as a mathematical diversion, but hardly what one would term simple or direct. According to the author's method, the designer may not say what the stroke—and consequently the piston speed—*shall* be; he must find out by calculation what it *will* be. The m.e.p. is the last thing determined and is calculated from the horsepower speed, and piston diameter and stroke. The more sensible method is to compute the m.e.p. first and then proceed to determine the cylinder dimensions in the same way that one would go about designing a steam engine. From the data in the book the m.e.p. can be calculated directly without traversing the tortuous route outlined by the author.

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The method of checking the calculations is original and amusing. The m.e.p. of a 75-hp. engine, for example, is computed, and the check consists in computing the m.e.p. of a 1-hp. engine the piston displacement of which is one seventy-fifth as great. Naturally if the results do not agree there must be an error in one or the other of the computations, and we have two sets of calculations to check instead of one.

In general, the book is of the usual character, with chapters on fuels and combustion, ignition, carburetion, governing, cost of power, general descriptions of various commercial types of engines, details of design, etc. The theoretical part is, as in most books on the subject, far too elaborate, and the practical part rather superficial. It seems to be largely a compilation from existing sources, and displays no particular originality in the selection or arrangement of the material. The errors in the text that are apparent from even a casual inspection indicate that the proof-sheets did not have the careful correction that one has the right to expect in books of a technical nature.

Factory Safety and Sanitation

REVIEWED BY C. E. CARSON*

THE MODERN FACTORY: Safety, Sanitation and Welfare—By George M. Price, Director, Joint Board of Sanitary Control in the Cloak, Suit and Skirt and the Dress and Waist Industries, New York City; formerly Director of Investigation, New York State Factory Commission. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. xx + 574; 257 illustrations. $4, net.

The short title that appears on the outside of the cover, "The Modern Factory," gives an erroneous impression, since the book deals entirely with safety, sanitation and welfare work. The only exception is the first chapter, which gives a historical summary of the rise and development of the factory system, and this chapter might very well have been omitted.

The second chapter discusses in a general way the working conditions of different industries. Other chapters take up factory fire prevention, accident prevention, factory lighting, factory sanitation, welfare work, factory ventilation, dusty trades, industrial poisons and fumes, factory legislation and factory inspection. Among the safety devices described in Chapter IV is the familiar one for a punch press. It is without doubt safe, because the operator must use both hands to trip the press. But from the production manager's viewpoint this type of device would be prohibitively slow. Safety on this job may be better attained by spending more money in the construction of the die and providing a gravity feed.

The book as a whole shows experience and careful preparation. It will be a valuable asset to the library of any large manufacturing establishment that has, or contemplates having, a department of safety, welfare and sanitation.

PIPE COUPLINGS. By R. S. Lord, Vice-President, Hope Engineering and Supply Co., Mt. Vernon, Ohio. [Reprinted from "Proceedings of the Engineering Society of Pennsylvania," Vol. 31, pp. 417-37 (June, 1915).] Address the author.

A useful and interesting review of couplings, or joints, for wrought-iron and steel pipes, with more particular reference to pipe lines for oil and natural gas, but with mention of water mains. Among the special joints figured are the Kimberly, Converse, Matheson, Dresser, Dayton, Hammon and Custer. Good words are said for

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plain-end pipe rather than those with hub and spigot. Mention is made of several plain-end water mains, 16 and 24 in. in diameter, laid across bridges in Pittsburgh; and it is added that plans have recently been considered "for a very large water-piping system likely to be constructed in this way."

Water-Purification Plants and Their Operation

REVIEWED BY ROBERT SPURR WESTON*

WATER-PURIFICATION PLANTS AND THEIR OPERATION —By Milton F. Stein, Assoc. M. Am. Soc. C. E., Assistant Engineer, Cleveland Filtration Plant. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. viii + 258; 95 illustrations, 11 charts. $2.50, net.

The object of the author, who is Assistant Engineer for the new Cleveland filtration plant, was the preparation of a compendium of special and general information primarily for the nontechnical operator of small plants, but also for those graduate chemists who fail to grasp the practical details of operation when first assuming charge of water-purification works.

The work is divided into the following chapters: Water and Its Impurities; Types of Water-Purification Plants; Physical and Chemical Tests; Bacterial Tests; Interpretation of Tests; Coagulation and Sterilization; Water Softening; Sedimentation; Filtration and General Operation. There are in addition 11 graphs for computing the results of the various determinations, the amounts of chemicals to be applied to various waters, the cost of coagulating chemicals and the strengths of chemical solutions. In the appendix are directions for the analysis of coagulants and for the preparation of standard analytical solutions, as well as specifications for chemicals used in water purification, and a weir table.

Rarely has so much useful information been brought into so small a compass. Especially worthy is the nontechnical description of the character of water and its impurities. In this the composition of water as affected by the geological conditions encountered by circulating meteoric water and the classification which these conditions make necessary are clearly elucidated. The author evidently believes in the method adopted in the best law schools, for he teaches by cases and illustrates by many examples. Some minor criticisms might be made of this portion of the book. Subterranean waters from gravel beds are not "usually" but sometimes high in iron, and *Crenothrix* is one of several iron bacteria found in ferruginous waters. But this chapter will bear reading by the most experienced.

Very wisely the author has given examples of typical water-purification plants, illustrated by perspective drawings that show clearly the general arrangements and methods of operation. The theory of filtration is discussed clearly and sanely and with due regard to modern theories of colloids. Some will be in doubt, however, whether the coagulum in water passing a rapid filter forms a porous blanket that strains the water, or films about the sand grains that remove suspended matter and bacteria by attraction and absorption.

The statement that slow filters will remove 25% of the color from water is rather low; 40% would be nearer.

The physical and chemical tests described are based on the standard methods of the American Public Health Association, abridged for purification-plant use by untrained workers. The principal tests are clearly outlined and well illustrated by examples and cuts. The user should bear in mind, however, that not all bacteria which ferment dextrose and lactose with the production of gas are *B. Coli*. No methods for the determination of dissolved oxygen, or carbonaceous or nitrogenous matter are given.

The terms alum, aluminum sulphate, and sulphate of alumina are used indiscriminately to describe one of the important chemicals used. The trade name of this is sulphate of alumina; it contains aluminum sulphate but is really a basic complex salt. Alum, which is a double sulphate of a nonovalent and a trivalent element, is rarely used for water purification, except in household filters.

The book contains much that will help the filter operator and suggest construction details to the designer. Typical data of operation and cost are given and rather precise directions for operation. The author also includes forms for recording the results of operation. It is to be hoped that in future editions it will be possible to modify these forms so that they will be more like those recently adopted by the New England Water-Works Association.

The charts which accompany the volume are ingenious and should be helpful to the operator. They are not so simple but that a cross reference in each case to the page where they are described would be a convenience.

Generally the work is to be commended because of its clear style and choice of illustrative material. The author's experience evidently has been confined chiefly to hard and turbid waters. This probably explains why so little space has been given to the purification of soft colored waters or to the peculiar problems connected therewith. The fact that the author has confined himself to known facts within his experience explains both the excellence and the incompleteness of the book. Reading it critically the reviewer finds it instructive, dependable and within its field valuable.

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Centrifugal Pumps Concisely and Clearly Treated

CENTRIFUGAL PUMPS—By R. L. Daugherty, Assistant Professor of Hydraulics, Sibley College, Cornell University; author of "Hydraulic Turbines." New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. x + 192; 111 illustrations. $2, net.

In this small volume Prof. Daugherty has made another fine contribution to engineering literature. He has produced a text conspicuously above the average in conciseness and clearness, infusing into it a peculiar quality of sustained interest and readability for anyone who is in the least interested in this complicated subject. These are indeed the same characteristics which mark the earlier companion volume to this one—Prof. Daugherty's "Hydraulic Turbines" (reviewed by H. E. Longwell in *Engineering News*, Nov. 13, 1913).

Mathematics is not spared in developing the theory of the many centrifugal-pump actions, but the mathematical discussion is not unnecessarily protracted and is easily followed. A commendable phase in these sections is the translation of mathematical expressions wherever possible into physical pictures. Comparison of theory with actual constructions and actions is made at each important step, and the reasons for departures in practice are generally well disclosed. Unusual coöperation with many pump makers must have been secured to make this possible. The commercial features set forth are skillfully handled. What schemes the Goulds, De Laval, Worthington, Wood,

Morris, Southwark, Chicago, Platt, Alberger, Allis-Chalmers, McEwen and other companies have used and what has been accomplished have been recorded, but always for some definite end and with complete absence of any intimation of advertising. This alone is an important accomplishment. All through the book are references to the somewhat parallel matters of hydraulic-turbine design, the development in the theory of those machines being employed where applicable—with frequent notes on the service and structural differences which prevent the centrifugal pump from being merely a reversed turbine.

The book first classifies centrifugal pumps and describes typical ones. Then there is a transitional chapter on installation and operation before the first installment of general theory. Head, power, efficiency and discharge characteristics of various designs are described and reasons for peculiar actions presented. Another transitional chapter, on disk friction, leads into a discussion of factors affecting efficiency. The latter part of the book briefly but adequately compares the advantages of centrifugal and reciprocating units, outlines the fields of service for the several designs of centrifugals, reviews some general theoretical laws, describes pump testing, adds some cost data, tells how a pump designer approaches his problem and finally appends some complete test data obtained by the author.

Direct-Current Machinery

REVIEWED BY CHARLES F. SCOTT*

PRINCIPLES OF DIRECT-CURRENT MACHINES—By Alexander S. Langsdorf, F. Am. Inst. E. E., Professor of Electrical Engineering and Dean of the Schools of Engineering and Architecture, Washington University. [Electrical Engineering Texts.] New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xxiii + 404; 313 illustrations. $3 net.

The appearance of this book is noteworthy, as it is the first one issued in a series of books to be known as the Electrical Engineering Texts, outlined by a committee of professors and engineers formed in 1909. Prof. H. E. Clifford is Chairman and Consulting Editor, and the members are Professors M. C. Beebe, E. J. Berg, G. W. Patterson and H. J. Ryan and Messrs. P. M. Lincoln, H. H. Norris, Elihu Thomson and W. D. Weaver. The aim is "a well-considered, carefully written series, each volume of which shall treat only of its subject matter proper, and in a manner that is uniform with the treatment in other volumes." The present book is of interest not only on its own account, but as indicating the educational and technical standards and the method of treatment to be anticipated in the volumes which are to follow.

The preface proposes "a reasonably complete treatment of the fundamental principles that underlie the design and operation of all types of direct-current machinery." Armature windings and commutation receive especial attention, comprehensive rules covering windings and an unusually extensive treatment of commutation being presented. The operating characteristics of generators and motors include new material, elucidated by the use of three-dimensional diagrams.

The book requires a knowledge of calculus, a preliminary grounding in physics and electrical engineering, and the ability to interpret rather intricate graphical diagrams. The preface states that the book has been prepared for junior and senior students. Granting that the junior student is prepared to take up this book as a text, the question may be raised whether all students should go into the subjects treated in this book as thoroughly as the book requires. It is an excellent and comprehensive reference book, but it may be too specialized for the average student. Few engineers, aside from designers, need to know very much about commutation, for example. For each designer there are a thousand who need to know the operating characteristics of motors; not merely the magnetic and electrical characteristics, but the mechanical performance, so that a machine tool or a fan or a hoist with its particular requirements as to speed adjustments and torque can be adequately supplied with suitable motor and control apparatus. If the present book is one of many in which the subjects receive uniform treatment, will the series not call for an amount of time and lead to a degree of specialization which the student can ill afford?

The preface asserts an effort to give prominence to the physical concepts by presenting the physical facts of the various problems and refers particularly to the last section in the book as an example of this procedure. The section is a ten-page description with graphical and mathematical analysis of a certain automobile lighting regenerator. There are some 40 equations, many of which require two lines across the page and employ a special list of symbols. The machine described is out of date, as later models do not serve as motors as well as generators; furthermore, the series winding is omitted, "experience having shown that its effects contributed little or nothing of value." The student is wise if he observes that it is "experience," that is, the intelligent dealing with physical things, and not mathematical analysis of an intricate order, which indicates what can be done. After "experience has shown that the series field can be omitted" then the post mortem examination discovers that "the analytical reason for this fact is clear from the form of equation (30)." Equation (30) contains 46 symbols.

It is well to be able to make mathematical investigations and it is well to be able to travel through those which have been made, but all students cannot afford the time for exercises of this kind, and the student who expects to specialize on automobile generators is apt to get the mistaken idea that the designing and building and testing of such apparatus are based on intricate mathematics. Inventors who devise ingenious machines do not usually begin with equations of the third degree.

The book brings together much excellent material in concise and intelligent form. It is a treatise and a valuable reference book. Its suitability as a textbook will be decided differently by different teachers, depending upon their point of view as to what the student should study.

OVERCROWDING AND DEFECTIVE HOUSING IN THE RURAL DISTRICTS—By Dr. Harvey D. Bashore, Inspector for Pennsylvania Department of Health; author of "The Sanitation of a Country House," "The Sanitation of Recreation Camps and Parks," "Outlines of Practical Sanitation.' New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. xi + 92; illustrated. $1. net.

The deplorable living conditions existing in many country districts are pictured by text and halftones. Land overcrowding, house overcrowding, defective buildings and overcrowded and defective school buildings are the main topics considered. The author states that the "observa-

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tions noted" were made mostly "in a typical rural farming community, inhabited by native-born Americans." Many engineers could testify to the existence of similar unhappy and unhealthful conditions in various parts of America.

Internal-Combustion Engine Valve Gears

REVIEWED BY JOHN J. FLATHER*

VALVES AND VALVE GEARS: Vol. II, Gasoline, Gas and Oil Engines—By Franklin DeRonde Furman, M. Am. Soc. M. E., Professor of Mechanism and Machine Design, Stevens Institute of Technology. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xi + 190; 216 illustrations. $2, net.

This work is a still further development of the book noted in these columns Mar. 14, 1912, which is now published in two volumes. The first volume of the present edition, reviewed here July 15, 1915, related to the valves and valve gears used in reciprocating engines and steam turbines. The second volume treats of the various types of valves and valve gears used in gasoline, gas and oil engines. In this volume, as in its predecessors, the subject is treated chiefly from the kinematic standpoint with a view to the actual layout of valve gears and the control of the gasoline, gas or oil. This constitutes a continuation of the subject as presented in Volume 1, but as the title implies, it relates solely to internal-combustion engines and has been prepared to meet the requirements of varying courses of study and also to satisfy the needs of those who are interested only in internal-combustion engines. The method of treatment is similar to that presented under the discussion of valves and valve gears for steam engines and steam turbines. The selection and arrangement of the material is most excellent, but it is hoped that in the next edition of the work the author will follow his previous practice and present numerous working problems under each division. The general scope of the work may be obtained from the section headings: General Characteristics of Internal-Combustion Engines; Commercial Applications of Various Forms of Valves and Valve Gears to Gasoline Engines; Aëroplane Engines; The Gas Engine; Oil Engines; Diesel Oil Engines; Comparison of Prime Movers.

The book is very rich in material of general interest to the engineer who desires to obtain a knowledge of the various types of internal-combustion engines. The first portion gives a very general although brief discussion of gasoline, gas and oil engines. It also includes a discussion of fuel and fuel apparatus, such as gas producers and the different types of carburetors and mixers. The various methods of ignition employed in practice are also given considerable attention.

In the commercial application of the several forms of valve and valve gears to gasoline engines, the principal types are discussed more in detail and their distinguishing characteristics pointed out. In connection with this phase of the work an interesting method of using sinusoidal diagrams in laying out the sleeve valve of the Knight engine is particularly worthy of note.

Under aëroplane engines the more important types are presented, and their construction and valve mechanisms are clearly shown by means of an excellent series of drawings and diagrams. Of particular interest are the kinematic analysis of the 7-cylinder Gnome revolving radial engine and the comparison of its mechanism with that of the well-known Whitworth quick-return motion.

The rest of the book is devoted to a consideration of gas and oil engines, including a review of the early types of gas engines and their cycles. Methods of speed control and ignition are presented for engines operating under various conditions, and considerable attention is given to the slow-combustion Diesel oil engine. This consists of a comprehensive description of the different types of this form of oil engine, which is now coming into such general favor for marine as well as stationary service. Valve mechanisms and timing diagrams of both the four-stroke and two-stroke engines are given kinematically, and various methods of control are discussed.

The book concludes with a brief comparison of prime movers in which a very good table is presented, showing the approximate rating of the various prime movers in general use, based on the thermal efficiency and cost of fuel per b.hp.

This book is more than a treatise on valves and valve gears of gas, gasoline and oil engines—it comprises a very comprehensive and satisfactory treatment of the internal-combustion engine, and, like its predecessor, it will appeal equally to the teacher of machine design and to the student of engineering.

Landscape Architecture and Gardening Explained

THE ART OF LANDSCAPE ARCHITECTURE: Its Development and Its Application to Modern Landscape Gardening—By Samuel Parsons, author of "Landscape Gardening." New York and London: G. P. Putnam's Sons. Cloth; 6x9 in.; pp. xxi + 347; 57 illustrations. $3.50, net.

DESIGN IN LANDSCAPE GARDENING—By Ralph Rodney Root, Assistant Professor of Landscape Gardening, in charge of Professional Courses, University of Illinois, and Charles Fabens Kelley, Assistant Professor of Art, Head of Department of Art, Ohio State University. New York: The Century Co. Cloth; 6x9 in.; pp. 278; 65 illustrations. $2, postpaid.

Books on gardening, landscape gardening and landscape artitecture have rapidly multiplied in the last two decades, but the two now under consideration are unique, each in its own way, and deserve a place in the library of the student, the collector and the professional man.

Taking up first the volume by the well-known writer and practitioner, Mr. Parsons, it may be noted that he has marshaled in masterful sequence extracts from the writings both of the great authorities on the art of landscape architecture and of many lovers of landscapes. These extracts, combined now with the author's comments on the quotations and again with his own remarks to which some of the quotations give emphasis, serve to show what landscape architecture is and how it may be attained.

Among the writers drawn from most frequently by Mr. Parsons is Prince Herman von Pückler-Muskau, a German prince who wrote in 1834 and who practiced on his own estate what he so eloquently taught in his book.

The author deals in succession with the principles of his art, the laying out of estates, enclosures, location of buildings, grass spaces, roads and paths, water, islands, rocks, grading, plantations, maintenance, gardens and public parks. These are treated in the fashion already indicated. In a final chapter the author tells in his own language and from his broad and varied experience what trees and shrubs may be chosen from for various purposes. A bibliography of perhaps 150 titles and a rather brief index close the volume. It should be added

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that the illustrations, mostly full-page halftone views, are well chosen, are truly illustrative and include a good majority of American subjects—many being views in Central Park, New York, with which the author has been connected.

The second of the volumes before us has two unusual characteristics for a book on landscape gardening—brevity and as nearly a scientific presentation of the principles of landscape design as could be expected of a book dealing with an art.

Professors Root and Kelley first give thumb-nail sketches of architecture, sculpture, painting, agriculture, horticulture and engineering as elements of landscape work. The principles of landscape design, of color and of planting are next presented. A series of problems—like an American home, school grounds and a golf course—are then discussed. Garden design is the last topic. There is a good and extensive index.

The illustrations include diagrams as well as halftones and run freely to foreign examples.

The book promises to be useful to all who wish to inform themselves in the principles and to make a modest beginning in the practice of landscape design. It can scarcely fail to interest any not too old in their own esteem to learn something from every earnest attempt to present an old but ever new subject.

Production of Pig Iron

REVIEWED BY RICHARD MOLDENKE*

LEHRBUCH DER EISENHÜTTENKUNDE Verfasst für den Unterricht, den Betrieb und das Entwerfen von Eisenhüttenanlagen—By Bernhard Osann, Professor an der Königlichen Bergakademie in Clausthal. Erster Band, Roheisenerzeugung. Leipzig, Germany: Verlag von Wilhelm Engelmann. Paper; 7x10 in.; pp. xiii + 668; 407 illustrations, 17 tables. 29 marks. Bound in linen, 30.50 marks.

The first volume of Prof. Bernard Osann's *magnum-opus* is before us. It is entitled (translated) "A Treatise on the Metallurgy of Iron" and deals with the production of pig iron. With usual German thoroughness this book forms, without question, the most complete compendium of blast-furnace literature in print, and should be in the library of every iron and steel producer and metallurgist.

Since every phase of the blast-furnace problem is very carefully detailed, one finds the history of the development, the necessary instructions for making the installation calculations and the latest types of construction illustrated. Hence the book becomes not only a reference volume for the student, but a vade mecum of the blast-furnace superintendent and engineer.

After covering the history of iron and the accompanying statistics, the author discusses the principles of combustion, the fuels that are available in the blast furnace and the ores of iron and their distribution. A series of chapters are devoted to the preliminary preparation of ores for smelting, such as their roasting, briquetting, sintering. Manganese is also included in these discussions, and the chemistry of limestone is ventilated.

The construction of the blast furnace, the refractories used, accessory details, blowing engines, with full calculations, cover over 100 pages of the book; and a very interesting exposition of the dry-blast problem, with reasons for its practical failure in the exceedingly economical mode of running furnaces in Germany, is appended.

*Consulting Metallurgist, Watchung, N. J.

Next comes the blast-furnace stove, with about 100 pages of hot-blast description and data. The furnace hoist, ore- and coke-handling machinery, furnace gases and the necessary cleaning apparatus, and finally the blast-furnace gas engine, its construction, heat economy, development, etc., constitute another large section of the volume.

The metallurgy of the blast-furnace process is next discussed. Temperature, heat balance, the nature of the pig iron produced, calculation of burden and slags made and the nature of the latter precede the operation of the furnace itself. This is gone into fully and the many troubles the furnaceman experiences are explained and advised upon. The recovery of values from the blast furnace is discussed, and directions are given for the operation of the stack for the different grades of pig metal required by the trade.

Pig iron from the electric furnace is given attention. Cost calculations, and the detailed plans of a blast-furnace installation complete the volume.

One cannot help agreeing with the author that the study of the metallurgy of iron is somewhat like that of medicine. One cannot duplicate the happenings of the furnace or the human system in the laboratory, nor can one see very much of what is actually going on within them; hence the necessity for constant study to enlarge the range of understanding, so that the results in practical operation may be more and more reliable and subject to more accurate prediction.

The book is cordially commended to the attention of the American iron industry and the hope is expressed that an English translation and the subsequent parts may soon follow.

Commission-Manager Plan

THE CITY MANAGER: A New Profession—By Harry Aubrey Toulmin, Jr., author of "Social Historians." New York and London: D. Appleton & Co. [National Municipal League Series.] Cloth; 5x8 in.; pp. xi + 310. $1.50, net.

The city-manager plan is so new and is so closely associated with the commission-plan of government, both in theory and practice, that it is not surprising to find this book consisting largely of an exposition of commission government and its advantages. In fact, the portion of the contents relating solely to the city manager and his work would make little more than a respectable pamphlet. The book is nevertheless useful. Its usefulness and effectiveness are increased by its interesting character and the enthusiasm of the author.

For concrete illustrations the author draws chiefly upon Dayton, Ohio, with frequent excursions to Springfield and a number of references to two or three other cities. Unlike many writers, Mr. Toulmin gives due credit to Staunton, Va., for taking the lead in appointing a city manager. In view of this and of the further fact that, as the author brings out, Staunton appointed a city manager because it lacked authority to adopt commission government, it is a bit surprising that almost no attention is given to the possibility of the employment of a city manager by other cities that lack either the legal power or the official or popular desire to adopt the commission plan. The fact is that a number of other cities have employed a manager by intent, and in others a masterful city engineer or commissioner of public works has become manager and achieved notable results.

It is a pity that the author should have been so full of Dayton and Springfield in particular and the commission plan in general as to have nearly ignored the majority of the cities actually under the manager plan and wholly ignored those which have utilized it without the official stamp of the name or endorsement of propagandists of the simon-pure city-manager plan. Some of the space now filled by repetitions and by "results" that are little but local self-congratulatory categories of activities might well have given place to broader, more thoughtful and more discriminating reviews of city-manager experience and approximations outside of Ohio.

The foregoing remarks are not designed to belittle the book but rather to point out how it may readily be improved upon, either by the author of the next book on this subject or by the present author, should he have the courage and energy to attempt a thorough rewriting of this volume, with liberal cutting at a number of places and a moderate but painstaking expansion at others.

A conspicuous service rendered by the author is his clear-cut and forceful exposition of the inherent and crippling weakness of the commission plan, in that it attempts to select administrative officers by popular vote. Having rendered this service, it is hard to see how the same man can condone, if not uphold, that provision of the Dayton charter which makes the city manager subject to popular recall. A broader field of vision, such as is to be expected in a book in the National Municipal League Series, might have prevented this inconsistency.

Surveying for the Self-Tutored

REVIEWED BY A. W. BEDELL*

PRACTICAL SURVEYING for Surveyors' Assistants, Vocational and High Schools—By Ernest McCullough, M. Am. Soc. C. E., author of "Engineering Work in Towns and Cities," "The Business of Contracting" and "Engineering as a Vocation." New York: D. Van Nostrand Co. Cloth; 5x8 in.; pp. ix + 42; 229 illustrations. $2 net.

The purpose of this book, the author says in his preface, is to meet the needs of students whose mathematical preparation does not extend beyond simple arithmetic. It is intended to be used as a text in high schools or vocational schools and for self-tutored men who wish to become surveyors.

Instruments for field and office, and their use, are described in detail. The chapter on chain surveying gives almost all possible ways of making linear measurements, with many geometrical and practical problems. Leveling and grading are described, and a page is introduced showing signals for communication at long range. Under compass surveying are given the use of the instrument in the field, notes on attraction and variation (a complete isogonic chart is found in the front of the book), balancing errors, computing lost courses and areas and plotting the map. Trigonometry is treated in simple language in one chapter, giving both the regular and graphic solutions of plane triangles, with problems; and the use of logarithms is explained. The transit and its parts are described in some detail, together with traverses and a little on stadia work. Some useful pages are copied from the Ainsworth manual on meridian observations. The chapter on surveying laws is well written and is more thorough than would be expected in a book of this scope. The author truly says that "much of the litigation over land lines would be eliminated if the lawyer could be prevented from interfering with the surveyor," and that much of this interference is due to the fact that the average lawyer does not recognize such a thing as "the error." The chapter on engineering surveying covers, in a descriptive way, surveys for various kinds of construction. In the appendix the simplest uses of algebra are explained.

As may be expected in a new edition, there are a few unimportant errors. The book is illustrated in detail with clear sketches, and the language throughout can be easily understood. There are several tables scattered throughout the book, including squares and roots, traverse tables, natural and logarithmic functions, stadia reduction and lengths of a degree at different latitudes. Some of the tables, however, are incomplete for anything but instruction.

This is not in any sense a reference book. It is suitable only for those with little surveying experience and small mathematical knowledge, being an elementary parallel of Tracy or Johnson; but it is very thorough in its field. No one who is starting out to learn surveying will make a mistake in choosing this book as a guide.

*Federal Building, Santa Fé, N. M.

DIELECTRIC PHENOMENA IN HIGH VOLTAGE ENGINEERING—By F. W. Peek, Jr. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xv + 265; 190 illustrations. $3, net.

The high-tension studies of the author in the laboratories of the General Electric Co. have become widely known to the electrical-engineering profession through his many papers before the American Institute of Electrical Engineers. These researches into the failure of materials under extreme electrical stress are now collected in concise form and related order, giving a most useful volume for designer or student—a text the merit of which is parallel with the recognized worth of the work described.

ROLLING-LIFT BASCULE BRIDGES—Their Inception, Development, and Use. Chicago, Ill.: The Scherzer Rolling Lift Bridge Co. Paper; 6x9 in.; pp. 38; illustrated.

The 20 yr. of history and development of this type of bascule bridge are reviewed briefly and interestingly. The bridge was invented by the late William Scherzer to meet the peculiar conditions for a railway bridge across the Chicago River, where the close proximity of two swing spans prevented the use of another swing span between them. That bridge was opened in 1895 and is still in use. Since then there have been interesting developments, especially in simplifying the operating machinery and in adapting the bridge to meet various local conditions. At home and abroad there are now some 200 of these bridges for railway and highway service, with spans ranging from 29 ft. to 310 ft.

The book business of the Myron C. Clark Publishing Co., 608 South Dearborn St., Chicago, Ill., has been taken over by the Clark Book Co., Inc., a new concern with offices at 27 William St., New York City. The list of books taken over will be extended in the near future by several volumes on economic subjects.

Under the title "Some Important Engineering Features of the Canadian-Pacific Railway" a number of articles describing recent railway, bridge and irrigation construction activities of this railway have been reprinted by "The Canadian Engineer" of Toronto. The articles are well illustrated by halftones and line drawings.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AUSTRALIAN REPORTS—Paper; 8x13 in.; illustrated.
Annual Report of the Sludge-Abatement Board of Victoria for 1914. Pp. 26. Annual Report of the Chief Mining Inspector on Dredge, Mining and Hydraulic Sluicing in Victoria for 1914. Pp. 16. Melbourne, Victoria: Department of Mines and Forests. Report on Commonwealth Demography, 1914 and Previous Years. Pp. 262. Melbourne: Commonwealth Bureau of Census and Statistics. Annual Report of the South Australian Railways Commissioner for 1914-15. Pp. 52. Adelaide, N. S. W. Annual Report of the Commissioner of Queensland Railways for Year Ended June 30, 1915. Pp. 145. Brisbane, Queensland.

AUTOGENOUS WELDING AND CUTTING — By Theodore Kautny. Translated by the Author and James F. Whiteford, M. Am. Soc. M. E. New York: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. xiv + 157; 130 illustrations. $1, net.

BEITRAG ZUR BERECHNUNG VON MASTFUNDAMENTEN—Von. Dr.-Ing. H. Frölich. Berlin, Germany: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. 60; 61 text figures. 2.60 marks.

THE BUILDING ESTIMATOR'S REFERENCE BOOK: A Practical and Thoroughly Reliable Reference Book for Contractors and Estimators Engaged in Estimating the Cost of and Constructing All Classes of Modern Buildings, etc.—By Frank R. Walker. Chicago, Ill. (30 North Michigan Ave.): The Author. Flexible leather; 4x7 in.; pp. v + 612; illustrated. $10.

BULLETINS, UNITED STATES DEPARTMENT OF AGRICULTURE—Washington, D. C. Paper; 6x9 in.; illustrated.
No. 300, Excavating Machinery Used in Land Drainage—By D. L. Yarnell, Drainage Engineer. Pp. 39. No. 304, Land Drainage by Means of Pumps—By S. M. Woodward, Drainage Engineer (revised with special reference to the Upper Mississippi Valley by C. W. Okey, Senior Drainage Engineer). Pp. 60.
Copies at 15c. each may be procured from the Superintendent of Documents, Washington, D. C.

CANADIAN IRRIGATION REPORT FOR 1914 (Ottawa, Ont.)—Part VII, Annual Report, Department of the Interior. Paper; 7x10 in.; pp. 222; illustrated.

CANADIAN SOCIETY OF CIVIL ENGINEERS—Transactions, Vol. XXIX; Part I, January to June, 1915. Montreal, Canada (176 Mansfield St.): C. H. McLeod, Secretary. Paper; 6x9 in.; pp. 379; illustrated.

CIVIL SERVICE BOARD, CITY OF OAKLAND, CALIF.: A Report and Review of Civil Service Operation from Organization of the Board on Sept. 5, 1911, to June 30, 1915. Including Rules and Regulations, and Sample Examinations. Oakland, Calif.: Frank Colbourn, Secretary of Board. Paper; 6x9 in.; pp. 242.

COAL MINING IN ILLINOIS—By S. O. Andros. Bulletin 13. Urbana, Ill.: Coal Mining Investigations, University of Illinois. Paper; 6x9 in.; pp. 250; illustrated.

COMPARATIVE RAILWAY STATISTICS, UNITED STATES AND FOREIGN COUNTRIES, 1912—Washington, D. C.: Bureau of Railway Economics. Bulletin No. 83. Paper; 6x9 in.; pp. 78.

THE CONSTRUCTION OF THE PANAMA CANAL—By William L. Sibert, Brigadier-General, U. S. A., formerly Member of the Isthmian Canal Commission and in charge of the building of the Gatun Locks and Dam and of the channel from Gatun to the Atlantic Ocean, and John F. Stevens, formerly Chief Engineer and Member of the Isthmian Canal Commission. New York: D. Appleton & Co. Cloth; 5x8 in.; pp. x + 339; 23 illustrations. $2, net.

THE CORROSION OF IRON: A Summary of Causes and Preventive Measures—By C. L. Wilson. New York: The Engineering Magazine Co. [Works Management Library.] Cloth; 5x8 in.; pp. vi + 178. $2.

THE DETHRIDGE METER—By V. M. Cone, Irrigation Engineer, United States Office of Public Roads and Rural Engineering. Fort Collins, Colo.: Experiment Station, Colorado Agricultural College. Bulletin 215. Paper; 6x9 in.; pp. 11; illustrated.

ENGINEERING THERMODYNAMICS—By James Ambrose Moyer, Professor, and James Park Calderwood, Associate Professor, of Mechanical Engineering, Pennsylvania State College. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. viii + 203; 71 illustrations. $2, net.

FORD METHODS AND THE FORD SHOPS—By Horace Lucien Arnold and Fay Leone Faurote. New York: The Engineering Magazine Co. [Works Management Library.] Cloth; 7x10 in.; pp. x + 440; illustrated. $5.

GENESIS OF THE CENTRIFUGAL PUMP—By Albert E. Guy. [Reprinted from the Proceedings of the Colorado Scientific Society, Vol. XI, pp. 49-102.] Denver, Colo.: The Society. Paper; 7x10 in.; illustrated.

THE HURRICANE OF SEPT. 29, 1915, AND SUBSEQUENT HEAVY RAINFALLS: Report of George G. Earl, General Superintendent, to Sewerage and Water Board of New Orleans, La. Paper; 6x9 in.; pp. 18.

IOWA STATE DEPARTMENT OF FINANCE AND MUNICIPAL ACCOUNTS (Des Moines, Iowa)—Annual Report for 1914-15. Cloth; 6x9 in.; pp. 276.

IRRIGATION PRACTICE AND ENGINEERING: Vol. I, Use of Irrigation Water and Irrigation Practice; Vol. II, Conveyance of Water—By B. A. Etcheverry, Head of the Department of Irrigation, University of California. (In three volumes.) New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiii + 213, and xviii + 364; 77 and 82 illustrations; 7 and 31 plates respectively. $2 and $3.50, net.

MINNESOTA SURVEYORS AND ENGINEERS' SOCIETY—Proceedings of Meeting, Feb. 24 and 25, 1914. St. Paul, Minn.: George H. Herrold, Secretary. Paper; 6x9 in.; pp. 253; illustrated.

MONTANA INSTITUTE OF MUNICIPAL ENGINEERS—Proceedings of Meeting, Jan. 18-20, 1915. Vol. II. Bozeman, Mont.: C. C. Widener, Secretary. Paper; 6x9 in.; pp. 49.

NEW YORK STATE PUBLIC SERVICE COMMISSION, SECOND DISTRICT (Albany, N. Y.)—Report for Year Ended Dec. 31, 1914. Vol. II. Cloth; 9x12 in.; pp. 396; illustrated.

PRACTICAL FORGING AND ART SMITHING—By Thomas F. Googerty. Milwaukee, Wis.: The Bruce Publishing Co. Cloth; 5x8 in.; pp. 144; 90 illustrations. $1, net.

THE PRINCIPLES OF DYNAMO ELECTRIC MACHINERY—By Benjamin F. Bailey, Professor of Electrical Engineering, University of Michigan. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xv + 314; 222 illustrations. $3, net.

PRINCIPLES OF LOCOMOTIVE OPERATION AND TRAIN CONTROL—By Arthur Julius Wood, M. Am. Soc. M. E., Associate Professor in Charge of Railroad Mechanical Engineering, Pennsylvania State College. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 271; 117 illustrations. $3, net.

REPORT ON THE CLIMATIC AND SOIL CONDITIONS in the Canadian Pacific Railway Company's Irrigation Project, Western Section (near Calgary, Alta.)—Ottawa, Ont.: Irrigation Branch, Department of the Interior, Canada. Bulletin No. 3. Paper; 7x10 in.; pp. 24.

RULES AND INFORMATION PERTAINING TO ELECTRIC SERVICE, METERS, WIRING AND MOTORS—Commonwealth Edison Co., Chicago, Ill. Paper; 5x7 in.; pp. 86; illustrated.

SAFETY ENGINEERING APPLIED TO SCAFFOLDS—The Travelers Insurance Co., Hartford, Conn. Cloth; 6x9 in.; pp. vi + 354; 127 illustrations. $3.

SCIENTIFIC MANAGEMENT AND LABOR — By Robert Franklin Hoxie, Associate Professor of Political Economy, University of Chicago; Special Investigator of Scientific Management for the United States Commission on Industrial Relations. New York: D. Appleton & Co. Cloth; 5x8 in.; pp. x + 302; $1.50, net.

SOCIALIZED GERMANY—By Frederic C. Howe, author of "The City: the Hope of Democracy"; "The British City: the Beginnings of Democracy," etc. New York: Charles Scribner's Sons. Cloth; 5x8 in.; pp. x + 342. $1.50, net.

TECHNICAL PAPERS, UNITED STATES BUREAU OF MINES—Washington, D. C. Paper; 6x9 in.; illustrated.
No. 116, Miners' Wash and Change Houses—By Joseph H. White. Pp. 27. 10c. No. 124, Accidents at Metallurgical Works in the United States During 1913 and 1914. Pp. 28. 5c.
Copies may be procured from the Superinendent of Documents, Washington, D. C.

THEORETICAL ELEMENTS OF ELECTRICAL ENGINEERING—By Charles Proteus Steinmetz. Fourth edition, thoroughly revised and entirely reset. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiii + 368; 194 illustrations; $3, net.

UNITED STATES GEOLOGICAL SURVEY PUBLICATIONS—Washington, D. C. Paper; 6x9 in.; illustrated.
Water Supply Papers—No. 352, Surface Water Supply of the United States, 1913; Part II, South Atlantic and Eastern Gulf of Mexico Basins. Pp. 84. No. 355, Surface Water Supply of the United States for Year Ending Sept. 30, 1913; Part V, Hudson Bay Basins and Upper Mississippi River. Pp. 181. No. 370, Surface Water Supply of Oregon, 1878-1910—By F. F. Henshaw and H. J. Dean. Pp. 829. No. 376, Profile Surveys in Chelan and Methow River Basins, Washington. Pp. 8. No. 377, Profile Surveys in Spokane River Basin, Washington and John Day River Basin, Oregon. Pp. 7. No. 378, Profile Surveys in 1914 on Middle Fork of Willamette River and White River, Oregon. Pp. 8. No. 379, Profile Surveys in 1914 in Umpqua River Basin, Oregon. Pp. 7. No. 388, Surface Water Supply of the United States, 1914; Part VIII, Western Gulf of Mexico Basins. Pp. 124.
Mineral Resources of the United States, 1914; Part II—No. 22, The Production of Asphalt, Related Bitumens and Bituminous Rock. By John D. Northrop. Pp. 347-362. No. 23, The Production of Lime. By G. F. Loughlin. Pp. 363-373. No. 24, The Production of Peat. By Charles A. Davis. Pp. 375-385. No. 25, The Manufacture of Coke. By C. E. Lesher. Pp. 387-442.
Bulletins—No. 615, Rhode Island Coal. By George H. Ashley. Pp. 62. No. 622, Mineral Resources of Alaska: Report on Progress of Investigations in 1914. By Alfred H. Brooks and Others. Pp. 373.
Professional Paper No. 95-G—Preliminary Report on the Diffusion of Solids. By C. E. Van Orstrand and F. P. Dewey. Pp. 14; 9x12 in.

WATER POWER ENGINEERING: The Theory, Investigation and Development of Water Powers—By Daniel W. Mead, M. Am. Soc. C. E., Professor of Hydraulic and Sanitary Engineering, University of Wisconsin. Second edition. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xvii + 843; 430 illustrations. $5, net.

WATER SUPPLY COMMISSION OF PENNSYLVANIA (Harrisburg, Penn.): Annual Report for 1914. Cloth; 6x9 in.; pp. 399; illustrated.

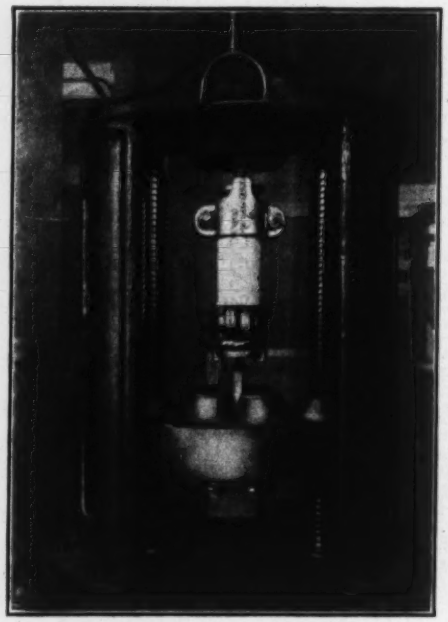
Field and Office

Special Grips for Large-Size Concrete Tensile Tests

By Charles M. Montgomery*

A simple and inexpensive set of grips for making tensile tests on fairly large concrete specimens, either drill cores or cast cylinders, is shown in the view.

Two sets of malleable-iron clamps made for use with 3-in. Knox hose couplings were procured and the lips



TENSION GRIPS FOR CONCRETE CYLINDERS

sawed off. The ends of the concrete specimens—in this case drill cores—were wrapped around with a layer of heavy web cut from a cotton hose to protect the concrete from direct contact with the metal clamps, and the clamps adjusted and loosely bolted in place.

Two heavy malleable-iron flanges 4 in. in diameter tapped for ½-in. pipe were reamed and threaded for a 1-in. U. S. Standard bolt. A section of 1-in. bolt, 21½ in. long, threaded over all, was then screwed into each flange and the end peened to prevent turning. One of these was placed between each of the clamps and the clamps bolted up tight, and the other end of the bolt threaded into a pipe attached to the heads of a testing machine.

*Inspector in charge of physical tests, Board of Water-Supply, City of New York.

A 38-Ft. Cobblestone Arch Raised and Moved

The Kress House Moving Co., of Los Angeles, Calif., carried out a unique piece of work recently when, in order to make room for widening the street, it moved a 38-ft. stone arch spanning a cemetery entrance. This arch, with its abutment piers, flanking sidewalk arches, etc., forms a piece of cobblestone masonry 105 ft. long. The portion moved is a 90-ft. length of the structure. The moving was made necessary by a change in the street alignment just at the entrance, which, beginning about opposite the right-hand main abutment (Fig. 1), amounted to a shift of about 6 ft. at the extreme left end.

To judge of the dimensions of the masonry structure, the following figures will serve: Span of main arch, 38 ft.; sidewalk arches, 7 ft.; section of main arch, 30x36 in.; main abutment piers, 6 ft. diameter at bottom, 4 ft. at top, 18 ft. high; sidewalk abutment piers, 4 ft. thick at bottom, 3 ft. at top, 15 ft. high. There is no reinforcement in the masonry.

Two 20x20-in. timbers 60 ft. long formed the main base or support for the structure in moving. They were placed on either side, stretching along arch piers and the wing wall, and the weight of the piers was transferred to them by steel needles of I-beams and rails. The main arch was carried by two 24-ft. lengths of plank laid against the intrados and supported by A-frames resting on the main timbers. Similar A-frames carried the left-hand sidewalk arch—the right-hand sidewalk arch, not being included in the section to be moved, had been cut loose alongside the main pier. When supports and needles were in position, the main timbers were jacked up to take the load and to bring runways into position. The moving was done by jacks pushing horizontally against the timbers.

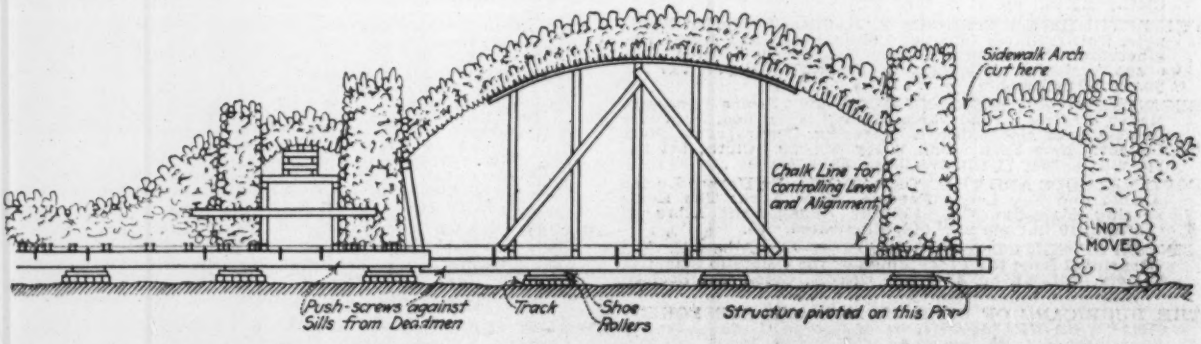


FIG. 1. SKETCH OF SHORING OF ARCH AND WALL, WITH ROLLER SUPPORT FOR MOVING

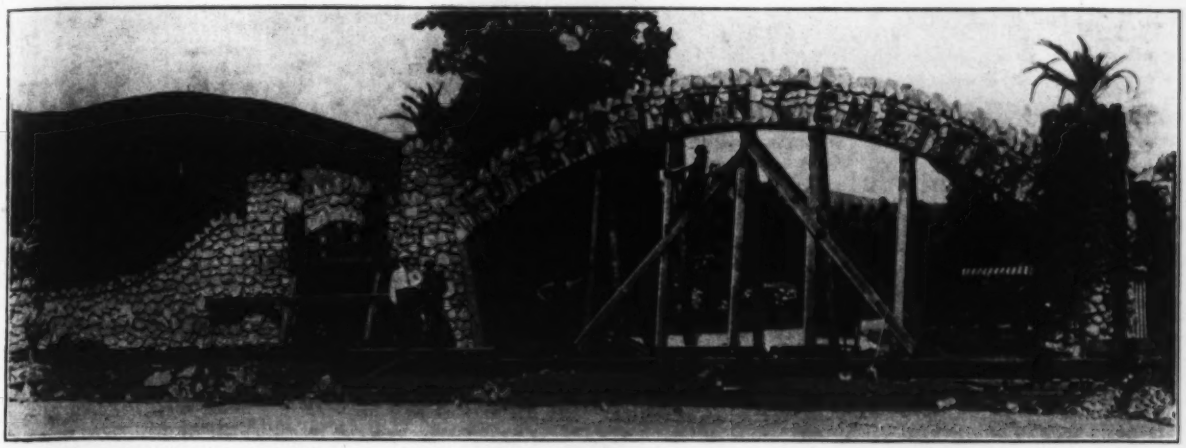


FIG. 2. COBBLESTONE ARCH AND WING-WALL MOVED 6 FT. BY REGULAR HOUSE-MOVING METHODS

As the arch is shown in the large view, Fig. 2, ready for moving, the pier at the right is about in the position of a pivot for the moving. The main arch and the structure to the left are supported on the needles and bents ready to be shoved back horizontally in their new location.

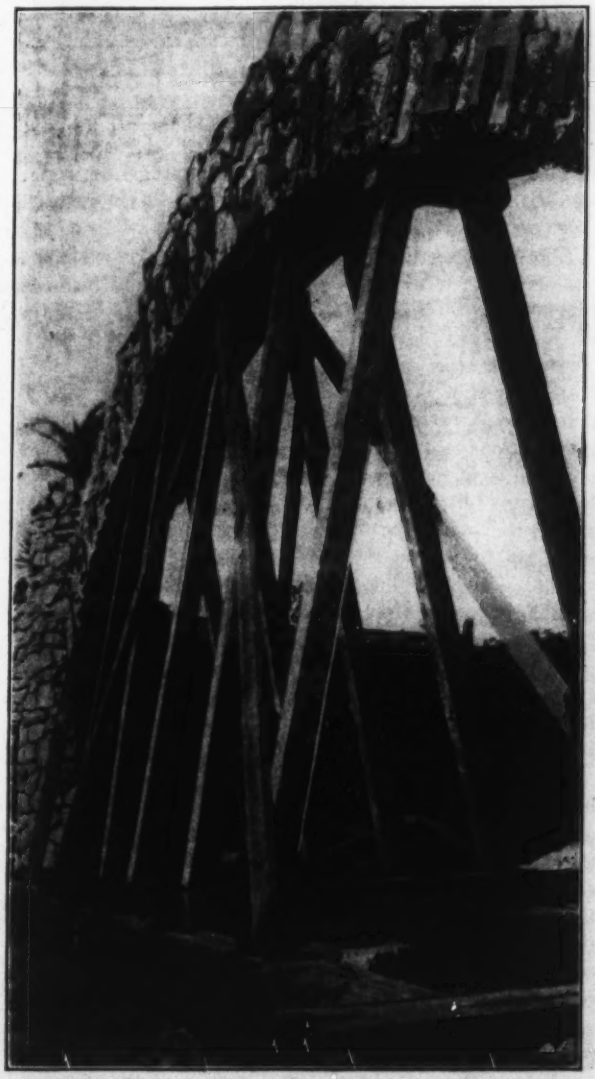


FIG. 3. HOW THE WEIGHT OF THE 38-FT. MAIN ARCH WAS CARRIED TO THE 20x20-IN. SILLS

The whole weight of the structure was about 125 tons. The contract price for the job was $650, which is about half the estimated cost of tearing down and rebuilding the masonry. The work was done within ten days. According to the architect, T. Paterson Ross, of San Francisco, the time taken was only one-fourth the time that it would have taken to wreck and rebuild the arch, the alternative originally considered. Not a crack was found in the masonry after the structure was moved and on its new foundation.

Building a Plate-Girder Bridge with a Locomotive Crane

A locomotive crane running on a temporary timber trestle, which it built, was used to place the foundations and erect the approach plate-girders of the Linden Ave. Bridge over the Great Miami River at Miamisburg, Ohio. E. L. King, superintendent for the Hezlep-Seaton Co., says that the chief difficulty in the foundation work was

FIG. 1. LAND PIERS WITH GIRDERS SET

to keep the water out of the coffer-dams. Excavation proceeded with a grab bucket, the soil being large gravel containing much water. After excavation, 217 ft. of steel sheetpiling was driven by a No. 2 Union steam hammer attached to the arm of a crane furnished by the Ohio Locomotive Crane Co. There were no leads, and the boom had to reach out 50 ft. to drive the sheeting and the foundation piles.

The bridge consists of two abutments and five piers; three 60-ft. plate-girder spans and two 160-ft. through-truss plans. One abutment went down 15 ft. below low water, two piers went down 20 ft. below low water, one

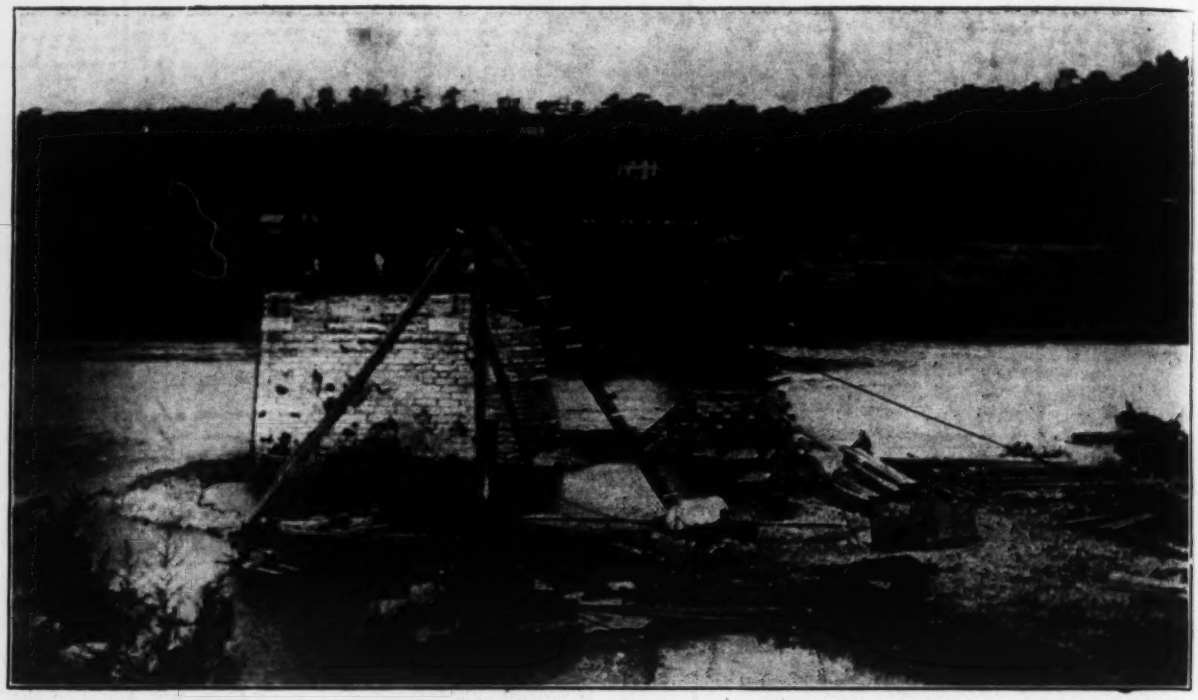


FIG. 2. ERECTION TRESTLE CARRYING CRANE; FOUNDATION STARTED

pier 10 ft. and two piers and the other abutment 5 ft. Foundation piles were driven for the three river piers and the west abutment. The crane erected the forms and placed the concrete for the five piers and the west abutment. On the east abutment derricks were used.

The girders for the west spans weighed 9 tons each and were unloaded from the cars and placed on the piers in six hours. The far girder had to be placed 45 ft. from the center of the crane track, but this was accomplished without difficulty. It was found possible to pick up a girder at a radius of 53 ft. straight ahead without resort to outriggers. In placing girders on the land piers, the crane track was 32 ft. from the center of the piers. The girders were first set out 30 ft., then one end was picked up and set in place, then the other.

Winter Concreting Under Canvas

By Albert M. Wolf*

SYNOPSIS—Sectional frames with canvas roof and tarpaulin sides. Temperature inside kept at safe point by salamanders. Sand, slag and water heated before mixing with cement.

Now that concrete-building construction is being carried on during winter months quite extensively, some very ingenious devices and methods have been used to protect the fresh concrete from freezing. On the new Ford Service building recently completed at Cleveland, Ohio, a novel method was used to house the concrete work. During the cold weather of the winter of 1914-15 portions of the floor were poured each day and over these were erected sectional frames covered with canvas, resting on supports along column centers. The housing was high enough to allow a man to stand erect inside. The sides were closed in with tarpaulins. All materials except the cement were heated before mixing—the water was heated by steam and the sand and the slag by steam coils in the bins directly over the mixer.

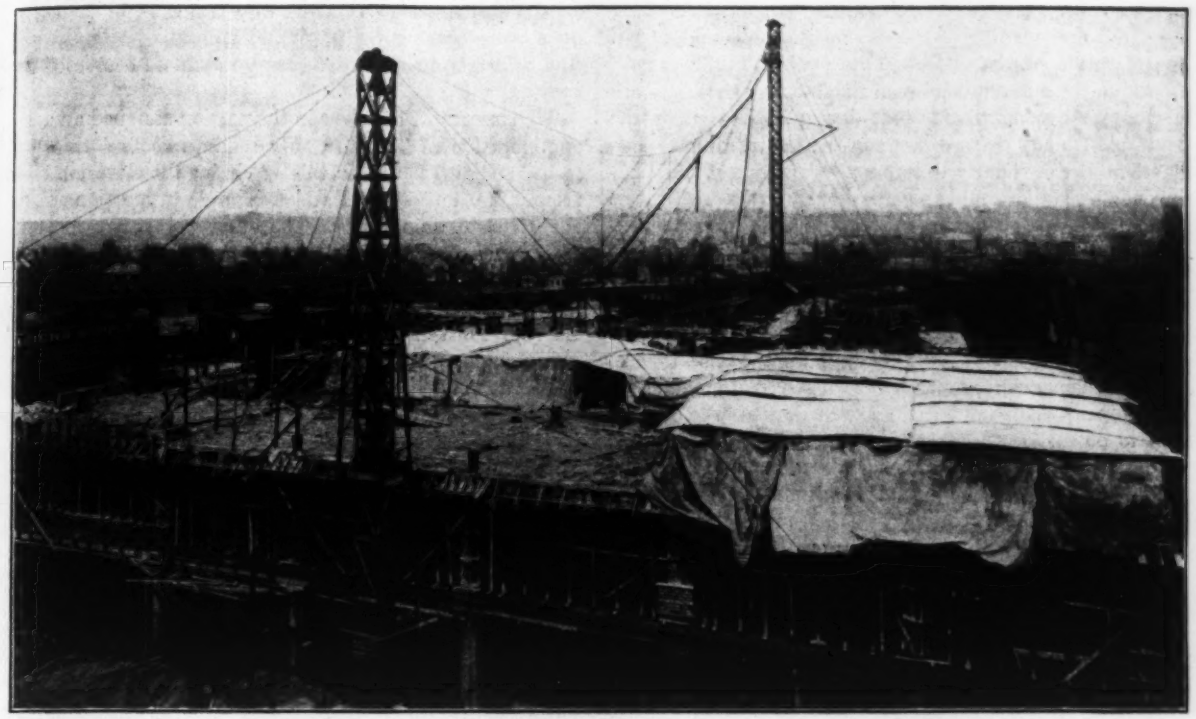
The "roof sections" were composed of trussed wood frames (four frames to a section). They were fastened together at the ends and covered with three 1-yd. strips of canvas, thus making sections 28 ft. long by 9 ft. wide. To support the canvas transversely between the wood frames, narrow strips or ribs 3/8 in. thick were placed diagonally between frames on about 3-ft. centers. The roof sections rested on and were fastened to continuous post-and-stringer supports at the ends on column center lines (one direction only), the uprights being placed within the projecting column bars and anchored thereto so as not to rest on the finished floor.

The frames were made up of 1x8-in. lumber trussed with heavy wire which when pulled up tight gave the frames a curved top surface. These sections were comparatively light and easily moved from one position to another. The side walls were formed by canvas nailed to the frames and fastened down to the floor at the bottom.

Inside of this canvas housing, salamanders filled with burning coke were placed on the concrete which had previously been poured, and also on the forms just beyond the fresh concrete, to maintain the temperature well above freezing while the concrete was setting. Since these coverings were set up in units which were at least the size of a panel, there was always room along the edge of the new concrete to set the salamanders, as all construction joints were made on panel center lines.

The housings were kept over each section poured for a period of three or four days, depending on the weather conditions, then moved and the surface of the concrete covered with straw or shavings.

*Principal Assistant Engineer, Condron Co., Chicago.



FRESH CONCRETE HOUSED UNDER CANVAS, WHERE SAFE TEMPERATURE IS MAINTAINED

The general contract for this building was held by Morrow Bros., of Cleveland; the architect was John Graham, of Detroit, while the structural features were designed by the Condron Co., of Chicago.

Reconnaissance Surveying with Single Aneroid Barometer

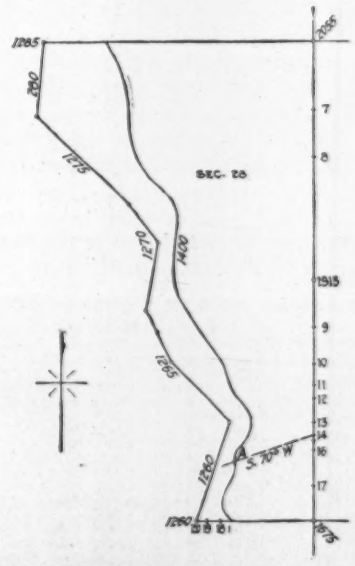
By Leroy A. Palmer*

Having had occasion recently to make a single-handed reconnaissance of about 65,000 acres in which elevations were desirable but great accuracy not necessary, I decided to see what could be done with the use of a single aneroid barometer. The instrument used was a compensated pocket "Tycos" with a 2½-in. dial and an adjustable altitude scale.

Readings were always taken with the instrument in the same position, preferably flat on the ground. The elevation was read by sighting along the pointer with one eye closed. After laying the instrument down, two or three sharp taps on the dial with the finger often helped to bring the needle to the proper position, indicated by a slight quivering; then after two or three minutes the pointer was read.

Readings were taken in the shade and on sand so hot that one could not lay his hand on it with comfort, and yet the readings showed no difference, nor was the instrument affected by proximity to the body in carrying it on a belt under the coat. If one is working in a rough or bushy country an instrument slung from the shoulder and carried outside the coat is more apt to catch or receive a severe jar than one carried on the belt and protected by the coat. It is a good practice, however, to put some tissue paper, loosely wadded, in the bottom of the case to cushion any jar that may be received—as, for instance, by the sudden and precipitate descent of a steep bank, as happened more than once on the trip mentioned.

At the beginning of the work a benchmark was chosen with an assumed elevation of 1,325 ft., which happened



SKETCH OF ANEROID SURVEY

to be the reading of the instrument at that point at the particular time. Each morning before leaving camp a reading was taken on the benchmark and the time noted. As each reading was taken during the day the time was noted to the nearest quarter hour, and on returning to camp in the evening the benchmark was read again.

*Mining Engineer, San Francisco, Calif.

The readings were then corrected as follows: Subtract the first reading of the day on the benchmark from the elevation of the latter. This is the "initial error." Compute the difference between the first and the last reading on the benchmark for that day and divide it by the number of hours elapsed between the two readings. The quotient is the "hourly difference." To correct the reading at any station, multiply the hourly difference by the difference in time between that reading and the first benchmark reading of the day, and apply the correction algebraically; then apply the correction for the initial error in the same manner. With the aid of a slide-rule a long list of readings may be corrected in a very few minutes.

Whenever possible, check readings were taken—that is, the barometer was read on a point whose elevation had been determined, whenever on subsequent days it was convenient to do so. If there was a slight discrepancy in these readings, the average was taken as the final elevation of the point. If the discrepancy was large, it was usually possible to determine which reading was the more nearly correct by comparing it with other elevations. For instance, we might have read *A* and *C* on one day, *B* and *C* on another and *A* and *B* on a third day. The two computed elevations of *A* might not agree, but by checking the elevations of the three points we could determine which reading of *A* to accept.

When the camp was moved and a new benchmark established, the same general procedure was followed as in taking the ordinary elevations; but one or more (the more the better) readings were taken on points whose elevations had already been computed, and from these the elevation of the new benchmark was derived. When possible, the series was closed in on elevations taken some time before. For instance, when a long circuit brought benchmarks 12 and 7 near together they were checked across and the mean of the computed elevations was taken as the new starting elevation. This is permissible, as the errors of the aneroid are not cumulative as are those of direct leveling.

The sketch and notes show a practical application of this method. The broken line on the west represents the meandered course of a stream as taken from the Government plats. A good dam site was found downstream at El. 1,150, with a possible height of dam of 250 ft. It was desired to know approximately what 40-acre tracts would be wholly or partly included in the flowage of such a dam—in other words, to map the 1,400-ft. contour.

NOTES OF ANEROID RECONNAISSANCE

Date	Station	Aneroid	Time	Elevation	Remarks
July 3	B. M. 11	2,350	8 : 00	2,435	
	Sec. corner	1,970	9 : 15	2,055	Secs. 21-22-27-28
	7	1,920	9 : 30	2,005	Gulch S 68° W
	8	2,020	9 : 30	2,105	Spur S 60° W
	¼ corner	1,830	9 : 45	1,915	Secs. 27-28
	9	1,700	10 : 00	1,785	Gulch N 70° W
	10	1,820	10 : 00	1,905	Spur S 70° W
	11	1,700	10 : 15	1,785	Gulch S 70° W
	12	1,750	10 : 15	1,835	Spur S 70° W
	13	1,670	10 : 30	1,755	Gulch S 65° W
	14	1,700	10 : 30	1,785	Spur S 70° W
	15	1,680	10 : 30	1,765	Gulch S 72° W
	16	1,740	10 : 30	1,825	Edge of spur S 70° W
	17	1,740	10 : 45	1,825	Edge same spur
	Sec. corner	1,590	11 : 00	1,675	Secs. 27-28-33-34
	18	1,290	11 : 30	1,375	Top of bluff
	19	1,200	11 : 30	1,285	2 ch. from river
	20	1,175	12 : 15	1,260	Meander cor. 28-33
	B.M. 11	2,350	2 : 30	2,435	

The contour was plotted as follows: The difference in elevation of the two points on the stream is 25 ft. The stream is divided into equal parts—five in this case, each representing a change in elevation of 5 ft. These divisions, with the corresponding elevations, are shown on the sketch. Now consider any point, as 14, which is on a spur bearing S 70° W. From this point draw a line S 70° W to represent the approximate course of the spur.

This intercepts the river in the portion assigned an average elevation of 1,260 ft. By scaling we find this line to be 18 chains long. In this 18 chains the elevation rises from 1,260 to 1,785 ft., and by simple proportion we fix the 1,400-ft. point at *A*. The other points are fixed in like manner and connected by the contour line 1,400.

The examination in question required that section lines be retraced, and as the aneroid readings were taken in the course of this work it can readily be seen that the foregoing method saved an immense amount of fieldwork. This was particularly the case on this reconnaissance, because much of the country was covered with extremely dense brush which would have required the services of an axman to run even a line of hand levels.

The weather, of course, has a vital influence on the work, and readings of this kind can be depended on only when atmospheric conditions are constant or when a change takes place uniformly. If the observer encounters several different kinds of weather in one day he might as well reject the readings taken.

The engineer is frequently called on to make examinations where great accuracy in the matter of survey is not required—where, for example, sights may be taken with a hand compass and distances measured by pacing. I believe that in such cases, if the weather conditions are fairly uniform and the topography is not too gentle, the method just described will be found to be very convenient and sufficiently accurate for the purpose.

Constructing a 10-Ft. Concrete Storm-Water Sewer

The work of constructing the south-side storm sewer at Columbus, Ohio, is proceeding rapidly. Essentially this is a 6,900-ft. concrete conduit to intercept a small creek and conduct it by a shortcut to the Scioto River. From the outlet on the river bank to near the foot of

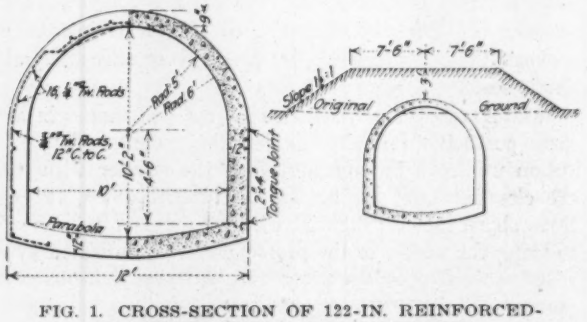


FIG. 1. CROSS-SECTION OF 122-IN. REINFORCED-CONCRETE SEWER, COLUMBUS, OHIO

the railway embankment of the Toledo & Ohio Central R.R. and the Hocking Valley Ry. is a 1,700-ft. section of a 120x122-in. reinforced-concrete structure of the cross-section shown in Fig. 1. This portion of the sewer is in a low-lying meadow subject to flood overflows. The sewer trench here is quite shallow.

The soil is a thin layer of loam overlying strata of stiff clay and hardpan. The trench is excavated by a 1-cu.yd. dragline excavator, no sheeting being required.

Half a dozen shovelers prepare the subgrade for the invert and lay an 8-in. tile subdrain close up to the excavator. The ditch water flows by gravity to a temporary sump on the river bank (from which end work was commenced), where a small boiler and steam pump are kept in operation.

The contractor has a 3-ft.-gage railway connecting with side tracks on the Hocking Valley Ry., where a central supply station and concrete-mixing plant have been established. A grab bucket is used to unload sand and stone from the cars to elevated bins. Concrete for the sewer invert is mixed at this central plant and conveyed to the

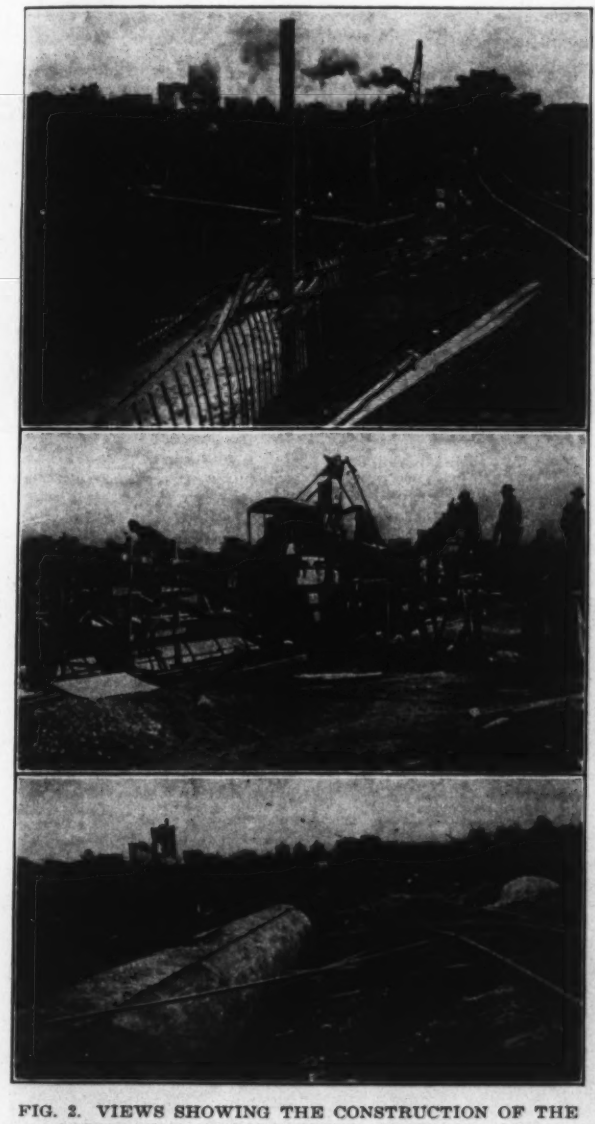


FIG. 2. VIEWS SHOWING THE CONSTRUCTION OF THE SOUTH SIDE STORM SEWER, COLUMBUS, OHIO

work by gravity in two 2-cu.yd. steel tip cars. The cars are hauled back by a dinkey.

For concreting the sewer arch a small ¾-cu.yd. batch mixer driven by a gasoline engine (shown in the middle of the three views) is used. The mixer is mounted on two flat cars so that it may be moved easily. It is blocked up as high as is safe, so that the concrete will flow through the chute; but with the chute at the inclination shown in the view one man is constantly required to push the concrete. The aggregates are dumped on the ground and carried in wheelbarrows up inclines to the mixer hopper.

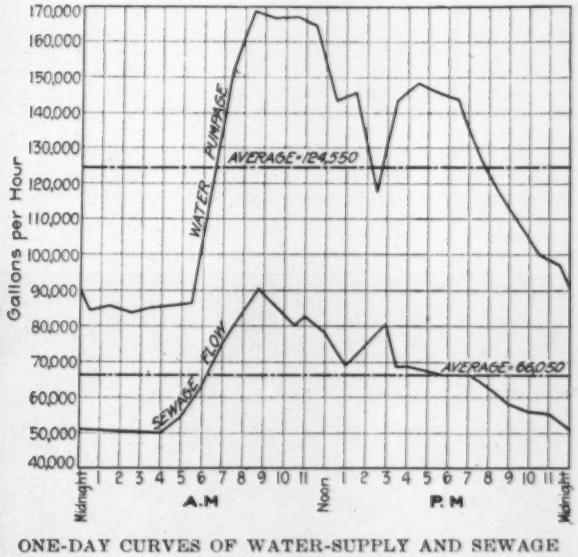
The concrete is 1:2½:5 mix, broken stone or gravel. The estimated quantities per linear foot of sewer are: Arch ring, 0.529 cu.yd.; side walls, 0.333 cu.yd.; invert, 0.437 cu.yd.—a total of 1.3 cu.yd. of concrete and 70.4 lb. of steel per linear foot. The contract price is $16.55 per linear foot.

The plans and specifications were prepared under the direction of Henry Maetzel, City Engineer of Columbus, with W. J. Weaver engineer in charge, and the contractor is the J. C. Carland Co., Toledo, Ohio.

NOTES

Water and Sewage Flow Curves—Curves of water-supply pumpage and sewage flow as measured in Lexington, Ky., by the Solomon-Norcross Co., engineers, are shown herewith. These curves furnish data on a subject more often covered by assumption than by definite fact. The close parallelism of the two curves is worth noting.

The fact that the sewage flow is little over half the water delivery is mainly due to the incompleteness of the sewer system. Only 65% to 70% of the population is connected to the



ONE-DAY CURVES OF WATER-SUPPLY AND SEWAGE FLOW, LEXINGTON, KY.

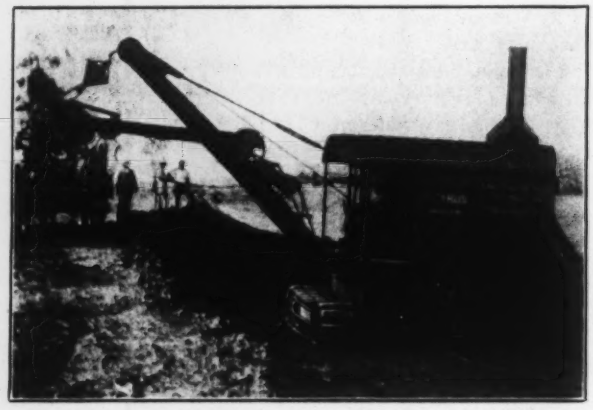
sanitary sewers. Further, 18% of the water pumped is used by power plants and railway companies.

The domestic supply system is fully metered. The consumption (all large consumers, or 1,410,000 gal., being deducted) is 1,770,000 gal. per day, or 44 gal. per capita per day. There are 6.2 inhabitants per service. The curves given are from sewer gagings made last July; the pumpage figures were obtained by correcting pump displacement for slip. A private company supplies Lexington with water. The sewers are separate.

A Portable Rail-Bending Machine operated by power is being used by the Cincinnati, New Orleans & Texas Pacific Ry. to bend rails for curves. The machine, with steam engine for driving the bending rolls, is mounted on a small car of the same height as a flat car. It is stationed at the car-repair shops and stands on a stub track which crosses a siding for the rail cars. In operation the bender car is placed on the crossing between a rail car and an empty car, the rails being run through the machine from one car to the other. The machine can be adjusted to bend rails for right- or left-hand curves and for any desired curve above 2°. It is necessary to set the rolls for a sharper curve than that desired for the rail, owing to the tendency of the rail to straighten after it leaves the roll. To bend rails for a 4° curve the machine is set for a 5° curve. A steam pipe from the power house of the shops

is connected to the engine on the car. The rails can be passed through the machine at the rate of about one rail per minute, and the cost is said to average 5c. per rail.

Revolving Shovel on Caterpillars—A revolving steam shovel mounted on caterpillar wheels has been used on county-road changes incident to the construction of the Chesapeake & Ohio Northern Ry. from Sciotoville to Waverly,



SHOVEL ON CATERPILLAR WHEELS BUILDING ROADS IN OHIO

Ohio. This road work—principally approaches to crossings—involved many shallow cuts; 15,000 cu.yd., all of it earth, had to be excavated. To avoid the frequent and costly moves, the contractor (George Maxwell, of Toledo) used the shovel arrangement mentioned. Heavy rains prevented fast progress during the first part of this work, but the caterpillar shovel demonstrated what it could do on muddy ground. The shovel is an 18-B Bucyrus, with a ⅞-yd. bucket. The spoil, removed by six 2-yd. wagons, is used for embankment filling along the new railway line.

Concrete Trestle in Forest—A reinforced-concrete trestle in a forest of large trees, as shown in the photograph herewith, represents a modern means of avoiding the fire risk of a wooden trestle in a case where continuity of service is vital. The trestle carries a water-supply conduit. For less important service the designer could hardly afford to neglect a cheap and highly satisfactory building material close at hand in favor of a very costly material requiring long transportation. As for the type of the viaduct, the picture clearly shows that kneebrace construction is relied on throughout to the exclusion of diagonals. Except for this the general type of design represents a copy of wooden- and steel-bent construction rather than a distinctive concrete design.

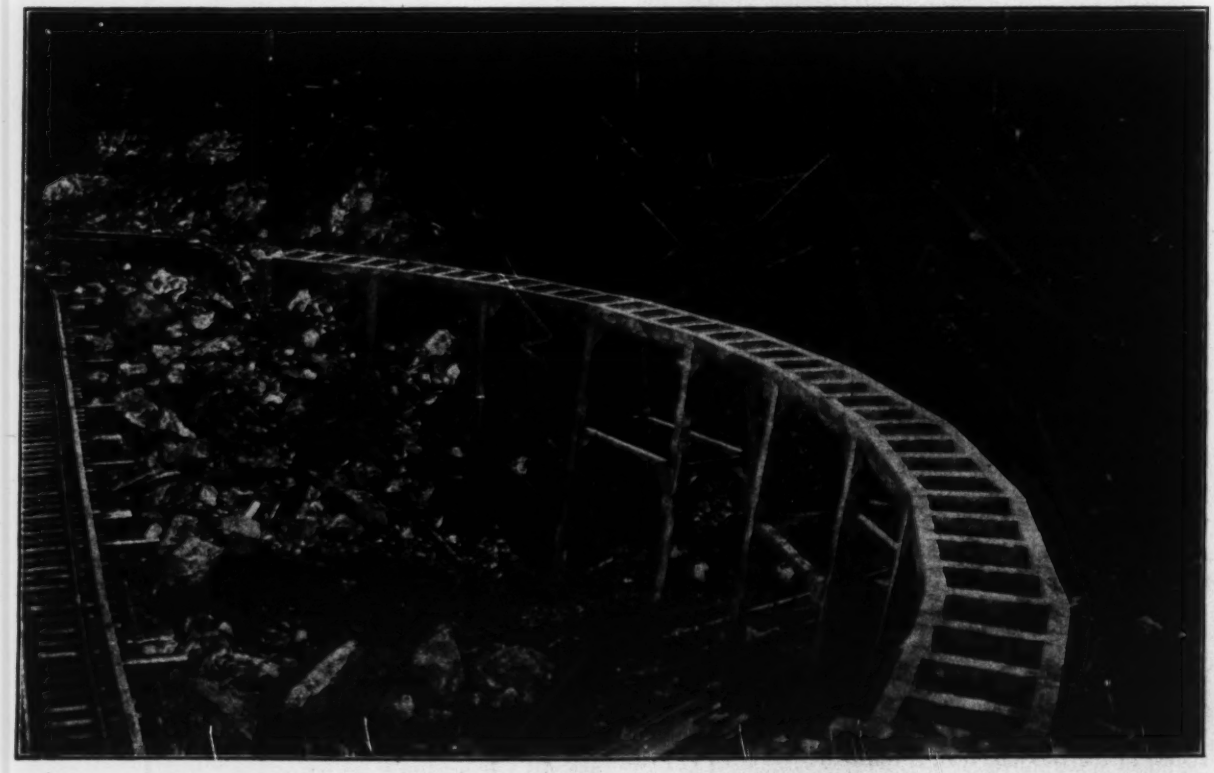
Strength of Annealed Form Wire—A reader inquired recently as to the strength of black annealed form wire. There is no standard grade of this wire, and unless the maker is known the strength would be uncertain. The American Steel and Wire Co. shows in its standards a minimum ultimate strength of 60,000 lb. per sq.in. for bessemer annealed and 40,000 lb. per sq.in. for basic openhearth annealed. This latter is extremely low and would be seldom approached

STRENGTH OF BLACK WIRE ANNEALED

Gage No. (Steel Wire Gage)	Diameter Inches	Tensile Strength, Lb. per Sq.In. 40,000	50,000	60,000
8	0.1620	824	1,030	1,236
9	0.1483	691	863	1,038
10	0.1350	572	715	858
11	0.1205	456	570	684
12	0.1055	350	437	524
13	0.0915	263	329	396
14	0.0800	200	251	300
15	0.0720	162	203	244
16	0.0625	122	153	184

within 15,000 lb. The elastic ratio for bessemer wire of this grade is given as 52% to 74%, elongation 18% to 25%; for openhearth the elastic ratio 40% to 55%, elongation 18% to 30%. Probably 50% elastic ratio (meaning ratio of yield-point to ultimate strength) might safely be counted on in all cases. The accompanying table, based on the American Steel and Wire tables for wire of 100,000 lb. per sq.in. strength, gives the strength of wires of 40,000, 50,000 and 60,000 lb. ultimate.

A Contractor's Water Tank for use on construction jobs can be made by connecting together a number of wooden barrels. One contractor, engaged on road construction, connected six or eight barrels by means of 1-in. pipes and placed them on a 10x10-ft. platform. Beneath the platform, which was 12 ft. above ground, there was an outlet pipe connecting with all the barrels.



REINFORCED-CONCRETE TRESTLE FOR SOOKE LAKE CONDUIT

Editorials

Why Not Experienced Men for Public Utility Commissions?

The State of New York during the administration of Governor Hughes led the way in the establishment of a thorough-going control of public utilities by state commissions. Other states which have followed the example of New York have looked to the New York Commission more or less for their precedents. Unusual interest therefore attaches to the action of Governor Whitman in removing from office Judge McCall, Chairman of the Commission controlling the utilities of New York City, and appointing in his place Hon. Oscar Straus, who was Secretary of Commerce and Labor in President Roosevelt's administration.

The announced reason for Commissioner McCall's removal is a violation of the New York law which forbids a member of the Public Service Commission from owning securities of any public utility over which he has supervision. A more important reason doubtless for this and other changes in the commission is the general belief that appointments to the commission in recent years have been made rather to award "plums" to men of political prominence than to select experienced business men competent to discharge the great responsibilities laid upon the commissioners.

The Hughes law establishing the Public Service Commission fixed the salary of the individual commissioners at $15,000 per annum, an unusually high figure for a public officer. The idea of those who drafted the law was that this high salary would make it possible to secure the appointment on these commissions of men of a caliber sufficient to command such an income in their private business, and further that men so liberally paid for their services to the public would be free from the temptation to accept graft in any form. It was also hoped that the governors of the state would appreciate the enormous responsibility placed upon the Public Service Commission and in making appointments to it would try to find men who were of such ability and reputation as to be worth such a salary.

This hope has not been realized. Appointments to the Public Service Commission in recent years have not been made because of the knowledge and experience of the candidates concerning the operations of public utility companies, but the selection has been made apparently for political reasons. Of course it does not follow that because a man is a politician he is either dishonest or incompetent. Ability of some sort is undoubtedly a requisite if a man is to achieve prominence in politics. It is increasingly clear, however, that in order to render the best service on a public utility commission a man not only ought to possess honesty and ability, but he should be reasonably familiar with the operations of public utility companies and with the practice of their control on behalf of the public, which has been developed during the past dozen years. As has often been pointed out, Germany far excels all other countries of the world in the excellence of its municipal governments. One reason for this success undoubtedly is that in Germany the business of managing a city's affairs is in the hands of experts. A man who makes a reputation for excellent work in a small city is often called to a larger city where he can make good use of the experience he has acquired. We have had the beginning of this sort of thing in the United States within the last two or three years under the city-manager system, where in a number of cases engineers experienced in municipal administration have been sought for and engaged as city managers in other cities than those where they had gained their experience.

We will not make a great success of commission control of public utilities in this country until the men appointed on the commissions are selected for their ability and *experience*. A very slight beginning has been made, it is true, in the appointment on the Interstate Commerce Commission of men who had previously made distinguished records by service on state utility commissions; but it ought to be possible in the appointment of public utility commissions to go outside state boundaries and select for appointment men who have made good records in the service of other states.

Undoubtedly before any such sweeping reform as this can take place, a great deal must be done in the education of public opinion. At present the public is distrustful in these matters and is even more likely to trust a politician with whose name it has some familiarity than it would be to trust a man with expert knowledge and experience of whom it has never heard. Until the public is better educated as to the value of experience in the control of public utilities it will usually be necessary to appoint men like Mr. Straus, who has been appointed to succeed Judge McCall, not because he has any special knowledge or experience in the work of the commission, but because he is a man widely known and possessing public confidence.

Military Preparedness and the Engineer

The annual message of the President to Congress proposes an enormous increase in the military and naval establishments of the United States. That the civilian engineers of the country are to play an important part in this preparedness program is a foregone conclusion. There are probably few American engineering societies which have not already listened to talks by military officers on national defense and heard the principles of military engineering explained. Several local societies have gone so far as to seek specific instruction in military science for their members. A committee representing the five great national engineering societies has been working with the War Department for months upon a method of utilizing these organizations in a scheme for national defense, and is soon to report on the legislation it has framed. Evidently, interest is not lacking.

The President proposes to increase the Corps of Engineers by 15 companies. At least 50 additional engineer officers will be required for this force, so it seems probable that civilian engineers may obtain some of these commissions. In the army as a whole about 2,000 additional commissioned officers will be required, and the logical candidates for these commissions, according to what engineering societies are being told, are the younger graduates from the engineering schools.

Moreover it is proposed to build up a volunteer army of 400,000 part-time men, to be raised in groups of 133,000 a year for a period of three years. A large number of volunteer officers will be required for these troops, as well as 750 permanent officers to train them; and here again the technical graduate and engineer are likely to come to the front. It has been publicly stated by responsible army officers that every technical graduate with an elemertary knowledge of military science is a potential army officer.

As to the methods by which military training for both regular and reserve officers is to be imparted, three schemes are proposed by the Secretary of War in his annual report. One is to organize a certain number of cadet companies to be attached to the regular army units. These cadets will receive special pay and will engage to serve one year with the cadet corps and five years in the reserve army corps. Their year in the cadet corps will consist of intensive training in all positions in the company from private to commissioned officer. A second scheme is to reorganize the military departments of the various colleges and universities under the direction of army officers, so as to make them in effect officers' training schools. The third method is to commission present officers of the National Guard, technical graduates of military training, civil engineers, railway men and others. It is also proposed to increase the capacity of the Military Academy at West Point to 770 students, which is 146 more than at present.

Additional training for reserve officers may be given in connection with the training of the Continental army or by their assignment for service with the regular army. Officers and men of the reserve force will receive pay on the same basis as the regular army for the time actually occupied in the service.

Repugnant as war and destruction are to every peace-loving American, they are doubly so to the engineer who has ever clung tenaciously to Telford's definition of engineering as "directing the great sources of power in nature for the use and convenience of man." The folly of diverting those sources of power to the destruction of life and property is perhaps more keenly appreciated by the engineer than by any other professional man, for the engineer spends his life in the design and execution of structures for preserving and safeguarding life and property—for such purpose indeed in the last analysis are sewers, water-works, bridges and nearly every other engineering structure which could be named.

Nevertheless engineers well understand that in the event of actual war, engineers everywhere will have to assume great responsibilities. In the European war the pioneers and the miners and sappers have become the main reliance of the advanced troops. The frontiers of belligerent European countries have been converted into practically continuous lines of trenches under the direction of engineer officers. The engineers charged with the maintenance and operation of lines of transport and communication are as essential to the military operations as the men behind the guns. On the other hand there are engineer troops whose service is wholly destructive; bridges, railways, tunnels, roads, etc., must be demolished behind a retreating army.

If a preponderance of sound public sentiment is for preparedness, engineers will be ready to respond to the patriotic duties asked of them. The military training they receive will have value anyway. Col. William M. Black, Corps of Engineers, U. S. A., has said that the chief fault to be found with civilian engineers in military work is the lack of a sense of proportion—a tendency to give more time and weight to methods and refinement than expediency justifies. For instance, in military topography the engineer must learn to sacrifice a certain amount of accuracy to speed, and yet retain a high degree of accuracy in the essentials for which the topographic survey is to serve. In other words the study of military engineering ought to cultivate judgment, prompt decision, discrimination and foresight—all excellent qualities for any engineer, civil or military, to possess.

Chicago's City Council Orders Railway Electrification

The publication of the report by the Chicago Association of Commerce Commission demonstrating that the electrification of the railways of Chicago is financially impracticable was promptly responded to by the City Council, which on Dec. 6 by a unanimous vote directed its Railway Terminals Committee to prepare such ordinances as would bring about the adoption of electric traction by the steam railways entering the city.

This action is of interest as showing the opinion of scientific investigation held by the average Chicago alderman. Opinions, however, whether held by individuals in their private capacity or as public officials, cannot alter facts. It may be easy to pass an ordinance obliging railway corporations to do certain things. It is quite another thing, however, to cause these things actually to be done.

By way of illustration, in certain cities of the Northwest the street-railway companies are by the terms of their franchise obliged to pave the space between and alongside their rails. As a result of the competition of jitney busses and private automobiles, however, these railway companies have abandoned all their paving work. When the city authorities order the companies to do what they have agreed to do, the companies reply that they haven't the money to do the work and are unable to get the money!

The question whether the railways entering Chicago shall spend in the neighborhood of $250,000,000 on electrification of their terminals because the aldermen of Chicago order the work done is a question a great deal broader than a mere conflict of authority between a city and certain railways, and a great deal broader than the interests of Chicago alone. Before the railways could borrow the huge sum of money involved in such an electrification they would have to gain the approval of the State Public Utility Commission and very likely of the Interstate Commerce Commission. The rights of many thousands of stockholders and bondholders are involved and the rights of communities in remote states. If the railways were to strain their financial resources to raise this great

sum and spend it on work yielding no financial return, it would seriously affect their ability to make needed improvements on other parts of their system possibly a thousand miles distant. It might be an important factor in making necessary an increase in passenger and freight rates. It is certain that the courts which may pass upon this matter will investigate very carefully the scientific and engineering facts in connection with it, even though the aldermen of Chicago may choose to ignore them.

Edison Fire Report Available

A year ago last week the engineering world was shocked by the news of the partial destruction by fire of the reinforced-concrete buildings at the manufacturing plant of Thomas A. Edison, Inc., at West Orange, N. J. The first reports that went out were indeed disconcerting, for it appeared that the previously accepted high reputation of concrete as a fire resistant had been seriously affected. Later news and views showed that the damage was largely to the contents of the buildings and that the whole catastrophe was mainly due to an almost childish disregard of the first principles of fire protection. The behavior of the concrete buildings under extreme conflagration conditions, however, was so interesting and in some cases so surprising that a thorough expert investigation of the fire and its effects was imperative.

Several such investigations were made, among them being the one conducted by a special committee of the American Concrete Institute, the primary results of which were announced at the annual meeting of the institute last February. It was not until last month, however, that the full report of the committee was made public in the "Journal" of the American Concrete Institute, dated August, 1915. This report comprises over a hundred octavo pages, fully illustrated with views and drawings, and contains in addition to the findings of the committee the discussions at last February's meeting and a complete story of the remarkably effective repairs of the buildings and the tests of the repaired sections.

The Edison fire was capable of teaching people more things about concrete and fire protection than any one textbook ever published. The American Concrete Institute and the members of its committee are to be congratulated in the way in which they rose to the occasion in translating these capabilities into certainty. With a generous distribution of this report among engineers and building owners, the public estimation of reinforced-concrete construction will be raised instead of lowered by the Edison fire.

Planning City Improvements

The careful planning of municipal improvements for years to come is notable by its absence in American cities. It is true that single improvements, particularly waterworks and sewerage systems, are so planned in a fair number of cities, but this is far from universal. Beyond these two kinds of public works there is very little systematic planning, and still less execution of such plans as are made. A comprehensive program of municipal improvements for a period of years is almost unknown this side the Atlantic.

That engineers appreciate the value of a municipal program there is no doubt, but comparatively few of them, in or out of city offices, have a clear vision of planning for the future. Fewer still have the courage to urge in season and out of season that their vision should be realized.

It is a pleasure to read in the very first number of "The Bulletin" of the St. Paul Society of Civil Engineers these words:

> When is St. Paul going to plan its future requirements? As little as $10,000 a year spent now in planning future extensions of sewerage, water-supply, streets, boulevards and bridges in a methodical and comprehensive way will save the next generation many times this amount, without considering the resulting chaotic condition that will be left as a legacy to future councils, city planners and engineers, if it is not done.

It is to be hoped that having struck so true a note in its first issue "The Bulletin" will never tire of sounding it, with such variations as will prevent monotony.

It is hardly necessary to add that the present seems to be an exceptionally good time to plan engineering works—not alone for cities—for winter is at hand and in some quarters construction is at low tide for other than seasonal reasons. Neither the rigors of winter nor the industrial exigencies of the period are such as to militate against careful planning for the future, both for individual classes of city work and for all the multifarious needs of the modern city.

Architects Have a Monopoly of Building Construction

Readers of *Engineering News* will recall the successful fight waged by the structural engineers of Illinois to obtain the right to construct buildings, which under a previously enacted law was granted as a monopoly to the architects. Some such movement will apparently have to be started in Michigan, for engineers who undertake work in that state on any form of construction may run foul of a new law just passed. According to the letter of this new statute, any structure which has a foundation, walls and roof is a building, and any person engaged in the business of drawing plans and specifications for such structures is an architect and must have a license from a state board in order to engage in such work.

As the contributor who sends the information regarding this new law points out on another page, under this broad definition water-works, filter plants, standpipes, pumping stations and a large variety of other engineering structures are buildings, and any engineer who makes a business of drawing plans and specifications for them is by the law declared to be an architect. It can readily be understood, however, that the board of examiners provided for by the act are not likely to license as an architect anyone who does not conform to their artistic ideals.

It is a curious illustration of the crude way in which important legislation is often drafted that after making the sweeping provision above recited, the framers of the law added a section which is almost equally sweeping in permitting *any* person, firm or corporation to make plans or specifications or supervise the work on any building to be constructed by said person, firm or corporation.

As this section reads, any building contractor can put up buildings without paying any attention to licensed architects, which is about the last thing the architectural profession desires. Furthermore, it would seem to permit an owner to hire, as a salaried employee, an unlicensed architect to design his building.

Letters to the Editor

Saving to Motor-Car Owners Through Smooth Roads

Sir—Referring to the editorial in *Engineering News* of Dec. 2, 1915, on the savings to automobilists by improving the roads, it may be of interest to mention some cost data that I have kept on a Ford car used over the rather bad roads of central Florida.

I have found that the average cost for about 7,500 mi. during two years has been slightly more than 6c. per mi. (not counting depreciation or interest on investment), while the figures kept by the maintenance department of the United States Office of Public Roads, as published in *Engineering News,* Apr. 22, 1915, show an average of about 4c. per mi. for light automobiles [also Fords] used in inspection work along the National Highway. I have kept careful itemized cost accounts for my car, and by comparing with the similar figures of the Office of Public Roads I find that my costs for gasoline and lubricants are only slightly in excess of the figures obtained on good roads, but the cost for repairs and replacement of damaged parts accounts for nearly all of the difference. My cost for tires has not been much in excess of that obtained on good roads.

The roads in this section are mostly of sand-clay construction. They soon develop holes, or bumps, or ruts, so that an automobile is subjected to very severe shocks unless running at very low speed. My costs for repairs and replacements have in no case been due to any accident, as I have never had one. I have rarely run faster than 20 mi. per hr. and never as fast as 35 mi.

I find that nearly all car owners with whom I have been able to confer keep no cost records that are even approximately complete; they are, therefore, in dense ignorance of their real operating cost. If this situation is general throughout the country I fear that the argument put forward would not carry much weight with automobilists—"Knowledge can convince knowledge, but knowledge cannot convince ignorance."

Gainesville, Fla., Dec. 8, 1915. J. R. Benton.

Alternate Specifications for Public Work

Sir—An article published in *Engineering News,* Nov. 25, 1915, by Daniel T. Pierce, is interesting as showing on the part of the courts cited a remarkable misapprehension as to the underlying principles of competitive bidding on public work.

The writer has had a large experience in preparing specifications and receiving bids for public work, and in prior years has had considerable experience in the preparation and submission of bids in behalf of contractors for public work. In more than 25 yr. of such experience he has met many officials to whose discretion was intrusted the letting of such contracts. He found the large majority of these officials to be honest men with little or no previous experience that would help them in this work. He found that such officials need the protection of law against the greed of contractors and material men, the ambition of politicians and the vanity of the officials themselves.

The laws governing the letting of contracts for public work are similar in most states, and the interpretation of these laws by the courts run along common lines, with the exception of the cases cited in the article in question.

The fundamental principle involved in the letting of contracts for public work, and the one which is embodied in the laws in question, is that the work should be done or the articles furnished at the lowest cost which is compatible with a sufficiency of quality and a fair profit for the contractor.

This matter of obtaining material or of accomplishing work at the lowest cost cannot be done unless the bidders are assured of fair play. Any municipality is in business too long and lets too many contracts to be able to profit from a momentary display of unfair dealing of any sort. Bidders should be certain that there will be no favoritism and that no political influence will be effective in the awarding of the contract. Furthermore, in order to be able to bid the lowest price which is compatible with a fair profit, the bidder should have a maximum of opportunity to buy in the open market.

The ideal condition of letting any contract is to specify a single standard of quality. This should be determined by the specifications, either by tests prescribed or by some standard article that is in the market. If two or more standard articles are specified as standards, the contractor or the seller should have the option to select, and the option should not be exercised by the municipality. This rule applies as well to patented articles, which are incidental to some large project. The municipality should specify the various articles which may be used for the desired purpose, and it should be left to the discretion of the contractor to furnish the one he selects. This policy will relieve the official of a vast amount of pressure from salesmen and their friends and will materially reduce the cost of the work.

The practice of receiving bids from each of the bidders on various paving blocks is vicious. When one contractor submits a low bid on one paving block and another contractor submits a low bid on another paving block, the official to whose discretion is left the awarding of the contract is immediately besieged by the various contractors and their friends, by the material men who furnish the article and by influential politicians. These men present to the inexperienced official the alleged merits of the various paving blocks in question and flatter his vanity until he believes himself competent to decide the matter. The wisdom of such a decision is doubtful, unless the award is finally made to the lowest bidder of all, and however the decision is made, the contractor whose bid is rejected always believes the decision to be unfair and to have been influenced by improper consideration.

The article in question cites a number of cases where there was attempted competition between the pavements of different character, such as brick, bitulithic and asphalt. Such competition is absurd unless all of the pavements are of equal merit and unless the lowest bid of all is to be accepted with option to the contractor to select the pavement. If one of these pavements will necessarily cost much more than one of the others, it is impossible for such a pavement to compete unless the bidder on this pavement has sufficient influence to offset the low price on the other pavement. Any bidder wastes his time who submits a bid for one pavement in such a competition, if the official has already made up his mind that some other pavement is much more desirable.

It is quite possible to submit bids on alternate forms of construction; for example, bids may be received on either brick or concrete sewers, where the option is left to the contractor to select the material after the contract is awarded. That will produce genuine competition; but where one contractor submits a low bid on brick and another contractor submits a low bid on concrete, and the friends of both advocate in various ways the relative merits of the two materials, there is an absence of the fundamental principles of competitive bidding.

The Illinois courts, in accordance with these ideas, have decided against the legality of competitive bids on a bridge based on two or more designs, for the expressed reason that such a method of bidding tends to fraud and collusion between the bidders and the public officials. While attempts should be made to guard against collusion between the bidders, the dangers of such collusion are much less than of collusion between officials and bidders or material men where bids are received in such a manner as to permit favoritism in the award of the contract.

In conclusion, the letting of contracts for public work should be conducted so that the desirable quality will be obtained by a proper specification which includes necessary tests or standards, and low prices will be obtained by giving to the contractor the option to furnish any article which is covered by the specifications. This option, to be exercised after the contract is awarded, is of very material benefit in obtaining a low cost to the contractor and to the public.

The official should have discretion to reject the bid of any bidder who is not responsible, that is, one who has not the ability, financial or otherwise, to do the work. The official should have no opportunity to favor any responsible bidder, but should be compelled either to award the contract to the lowest responsible bidder or to reject all bids. All bids should be identical, except as to prices and names of bidders. There should be in no bid special conditions or qualifications that are not contained in all bids.

C. D. Hill,
Engineer, Board of Public Improvements.

Chicago, Ill., Dec. 6, 1915.

How the Transcona Elevator Settled and Tipped

Sir—This is to point out some inaccuracies in your editorial comments on the "Culebra Slides at Panama," where you refer to the Transcona elevator case. You cite this incident as an example of the sudden apparent change to a state of plasticity of a subsoil under certain conditions of moisture and pressure. To quote your own words: "The same soil carried the same load for a long time, with no yielding; but when some slight change in its nature—no doubt due to an increase in water content—occurred, quite suddenly the bed of clay failed, . . ."

Now the actual facts are as follows: The structure was commenced in the spring of 1912, a phenomenally wet spring, and completed, as far as building operations were concerned, in the spring of 1913. The summer of 1913 was spent in adjusting the machinery and in preparing for the grain rush from the Western Provinces in the fall. The computed dead-load under footings of the Storage Annex was 2,600 lb. per sq.ft., and no settlement other than is to be expected in a building of that magnitude was observed during this period. The building was put into operation in the first week of October. The capacity of the elevator is one million bushels, and the additional load induced on the footings when the building is loaded to capacity was computed at 4,000 lb. per sq.ft., giving a maximum load of 6,620 lb. per sq.ft. Handling the grain proceeded steadily until Oct. 18, the date of failure, when approximately 850,000 bushels of wheat had been stored, the corresponding foundation load being 6,100 lb. per sq.ft. The settlement was sudden, and equilibrium was attained in about 12 hours. Meteorological reports show that the rainfall for the preceding two months was very slight over the whole province. This would appear to prove that increase of load, and not of water content, was the immediate cause of failure; that the viscosity was overcome by pressure and not by dilution.

There is no doubt, however, that a waterbearing stratum played an essential contributing part. A series of borings showed practically uniform conditions over the whole site, thus: About 52 ft. to solid rock, made up of 35 ft. of stiff, impermeable "blue" clay, 5 to 7 ft. of greasy, water-bearing, yellow clay and gravel, and the remainder coarse gravel and disintegrated limestone. The sequence of events would appear to be: A sudden vertical subsidence of about 12 in., due to the increased pressure overcoming the viscosity of the semiliquid stratum; a lean toward the west due to a dip in the bedrock; increased unit pressure consequent on the momentum gained and the lessening of bearing area finally rendering plastic the impermeable blue clay.

My apology for burdening you with these details is that it is evident your source of information cannot have been reliable in this particular instance; and as by associating the case with the masterly work of Governor Goethals you give it so much prominence, I feel in duty bound to correct your misapprehensions.

P. Burke Gaffney, B. E., B. Sc.

Winnipeg, Man., Dec. 2, 1915.

A Sewage-Disposal Problem

Sir—If the writer of the inquiry on page 1140 of your issue of Dec. 9 will write to the Bureau of Animal Industry, Department of Agriculture, Washington, D. C., he will probably be able to secure some useful advice concerning the utilization of the liquid wastes from cow sheds accommodating about 700 head. These have a considerable fertilizing value and are often handled separately from the domestic sewage of farm buildings.

Aquarius.

Concrete Cotton Terminals and Warehouses at Atlanta

SYNOPSIS—What is claimed to be the largest cotton warehouse in the world now under construction at Atlanta, Ga. Distinguished not only by size, but by rapidity in construction. Work started in September of this year; cotton storage started early in November. Involved 200,000 cu.yd. excavation and six large buildings on 40-acre lot. Fireproof construction results in marked reduction in insurance rates.

The European War and the consequent depression in the cotton market are responsible for the construction at Atlanta, Ga., of one of the largest, if not the largest, cotton-handling and storage warehouses in the world. The plant comprises six large reinforced-concrete buildings—the largest 240x1,100 ft. in plan—two cotton compresses and a complete system of railway connections and telpher transfer. It covers practically all of a 40-acre plot of ground about two miles from the center of the city and alongside the main line of the Central of Georgia R.R., with track connections to the Southern R.R. Three months ago this tract was a wooded, roughly contoured lot. Today over 900 men are working at tree-cutting, earth excavation and building erection, two of the warehouses are practically completed and each day trains are bringing in cotton to be stored at one side of a building the other end of which is still under construction. The total cost of the work will be about $1,000,000. It is being built under the direction of Arthur Tufts as designing and constructing engineer, by the Atlanta Warehouse Co., of which the local capitalist, Asa G. Candler, is president.

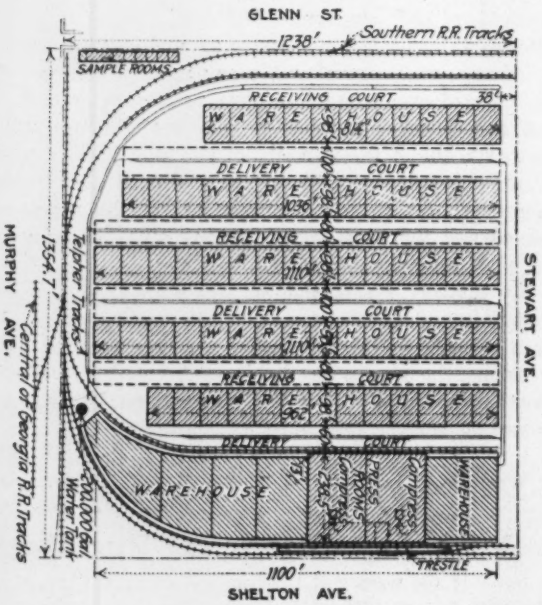


FIG. 1. PLAN OF ATLANTA WAREHOUSE CO.'S COTTON TERMINAL AT ATLANTA, GA.

On account of the present war it has been impracticable to market the cotton crop of Georgia at anything like reasonable prices, and this plant is intended primarily to offer to the farmers, merchants and banks ample facilities for storing and financing their cotton. Special attention has been paid to the facilities for storing and transferring the bales so that warehouse charges may be as low as possible, and the fireproof construction and ample fire protection provided have resulted in a great reduction in insurance rates. It is stated by the company that a rate of 20c. per $100 per annum has been secured, which means that a bale of cotton can be insured for one year for 10c., the lowest rate now existing in the South. The facilities of the plant are being offered to anyone that wishes to store his cotton and to borrow money on it, as well as to those that wish the usual warehouse accommodations.

The general layout of the plant is shown in Fig. 1. It consists of one large building—a combination of press rooms and warehouses 238 ft. 6 in. wide and over 1,100 ft. long—and five other warehouses, each 98 ft. wide and varying in length from 814 to 1,110 ft. Railway tracks run along both sides of the main building and down the opposite side of the lot, and overhead trolleys connect all parts of the various warehouses with the presses and the loading tracks. Between each pair of warehouses is a wooden covered shed and a concrete platform which is used either as a delivery or receiving court. In one corner of the lot is a concrete office and sampling building about 250x25 ft. in plan, and just off the main building is a 158-ft. high reinforced-concrete water-tower of 200,000 gal. capacity, which will supply the sprinkler and fire-protection system.

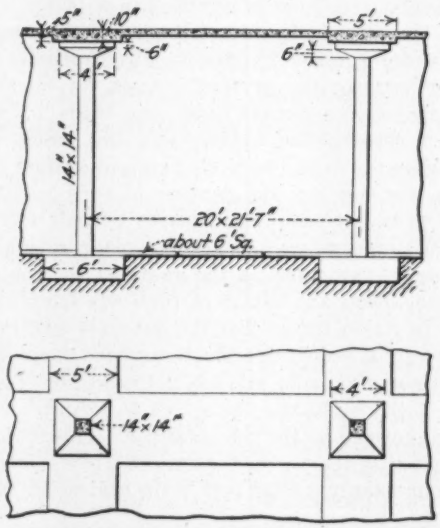


FIG. 2. TYPICAL PANEL OF REINFORCED-CONCRETE WAREHOUSES

All of the buildings are of reinforced concrete, of uniform type, varying only slightly to meet special conditions. Except for warehouse *G*, at the lower end of the main building, which is of two stories, all of the warehouses are one story high. The typical construction comprises square straight-rodded reinforced-concrete columns

resting on enlarged bases, which foot directly on the clay bottom, and carrying in panels about 20 ft. square a flat roof slab supported by rectangularly placed shallow girders. A typical panel without the reinforcement, which varies slightly with conditions, is shown in Fig. 2. The outside walls are of 12-in. thick concrete, and sawmill has been set up on the ground and also a bar-bending plant, so all material is delivered in the rough and worked up as needed.

Slag shipped in from the Birmingham district at the rate of 8 to 10 carloads per day is being used as aggregate for the concrete. All steel is rolled right in Atlanta.

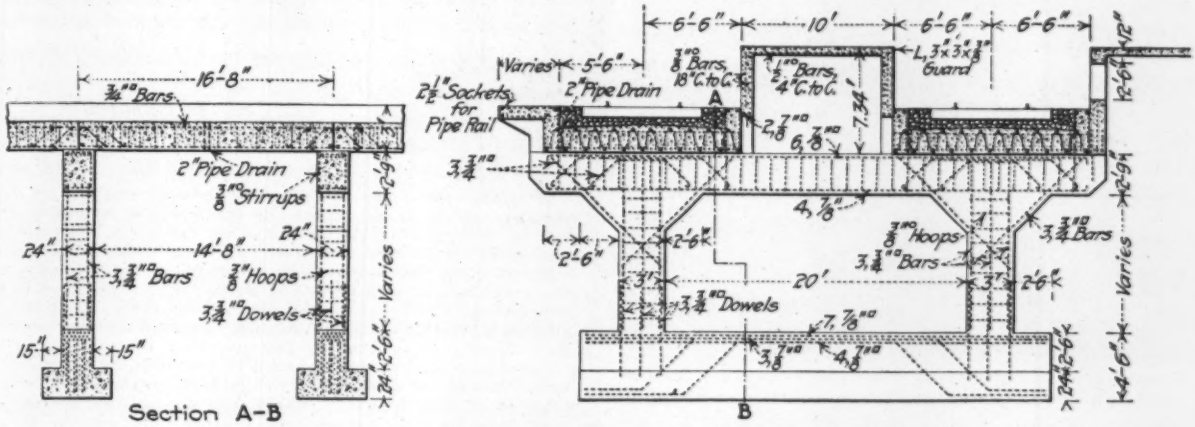


FIG. 3. DETAILS OF RAILROAD TRESTLE ALONGSIDE OF WAREHOUSE

each warehouse is separated into sections about 75 ft. long by 8-in. concrete firewalls provided with fuse-link fire-doors. There are no expansion joints provided either on roof or walls in any of the buildings. The floor, however, is made up of 6-ft. squares of concrete laid directly in the earth in checkerboard fashion, with tar-paper joints. The roof of the main building is cantilevered beyond the outer row of columns to provide a covered way for the outside platforms there. Ventilation and light are secured through skylight monitors.

As the ground slopes sharply down from the front end of the main building, the railway track on the outside of that building had to be carried on a trestle, the details of which are shown in Fig. 3. This consists of unbraced column bents spaced 16 ft. 8 in. longitudinally and 23 ft. transversely, founded each on a continuous inverted T-beam base and carrying over each column a transverse floor-beam. Centered over each column is a ballasted railway track resting on a continuous reinforced-concrete slab, while the space between tracks is occupied by an elevated reinforced-concrete platform which comes level with the car floors.

The main warehouse is equipped with two Webb high-density compresses, which are capable of compressing cotton to a density of 32 lb. per cu.ft. as against the work of an average compress, which is 22½ lb. per cu.ft. One of these presses is already in service; the other will be placed when required.

The construction has been carried on with the utmost rapidity. The lot was not entered until the last part of August, when tree-cutting commenced. Steam shovels started reducing the grade the first week in September. The greatest cut made was about 20 ft. in the characteristic Georgia red clay, which is being rapidly moved by dinky trains to level up the low places on the ground. Footings were made by cutting square holes in the stiff clay and filling them with concrete, on which the column forms were erected. All form work has been standardized, and as the panels are only of two or three sizes, the forms are being used over again several times. A Concreting is being carried on from five separate plants, which are moved from place to place as required. Each plant comprises a mixer, the feed trough to which is sunk below ground, and a low timber tower which elevates the bucket to the roof level, where the concrete is wheeled in buggies to the needed location. All of these plants are driven by steam, piped from a central plant.

Hartford Water-Works Progress*

Due to metering, the city has reduced consumption to 70 gal. per capita per day—giving now about 9,500,000 gal. per day. In 1916 the new system will make available 26,000,000 gal.

Some cast-iron pipe laid in 1854 and in continuous service has been replaced to increase capacity. It was horizontal-cast uncoated pipe and was somewhat tuberculated and filled. If the size had been ample it could have been cleaned. Sections were studied for condition and flow. A 4-in. pipe gave the capacity of new coated 2½-in. In the new work of the City of Hartford over 16,000 tons of cast-iron pipe had been purchased, and the rejections ran from 3 to 62% of various lots, the average being 11%. The rejections from the maker of the largest amount ran about 7%. The cost of inspection was 28c. per net ton of accepted pipe. Since careless foundry methods, lack of skilled labor and improper foundry mixtures were to blame, it was advocated that the maker should pay for the inspection of rejected pipe in excess of 10%.

The per capita use of water in Hartford has been studied, and the distribution by main purposes found to be as follows: Public uses, 3 gal. per day; domestic service, 34; manufacturing, 19; leakage and unaccounted for, 14; total, 70 gal. The amount actually drawn by the fire department was very small (½ pint per capita per day), though the rate of demand was extreme.

*From paper by Chief Engineer C. M. Saville before New England Water-Works Association.

Architects' License Law with Sweeping Provisions

By Herman K. Higgins*

Some extracts from the recently enacted Michigan license law for architects are here given. At first glance it would appear that engineers are not affected, but a closer study shows that the enactment may be construed by the courts to mean almost anything.

Section 1 and the sections from 3 on contain the originally intended enactment and provide machinery for enforcement, incidentally levying a tax on all architects. The fundamental requirement, that unqualified persons shall not use the term architect, is not only perfectly just, but so fair and right that we all, as engineers, applaud it. With these sections we have no possible quarrel.

With Section 2, however, the case is altogether different. Purporting to define the term architect, it entirely ignores the architect proper, but includes practically everybody else engaged in construction work. Not content with so doing, the law goes on to define "building" in such manner that it omits all reference to much that is legitimately architecture—for example, monuments, landscape work, town planning, etc.—and includes such entirely nonarchitectural work as caissons, tunnels, cranes, filters, etc.

Taken altogether, the law stands as prohibiting to all persons not registered as architects the use of any words, letters or devices to indicate that the person using the same is engaged in the business of drawing plans and specifications for the erection, enlargement or alteration for others of structures consisting of foundations, walls and roof, with or without other parts.

It will thus be seen that in the improbable case that the courts sustain these definitions and undertake to enforce them logically, it will be unlawful to either advertise or practice most branches of engineering in the State of Michigan. It will also be necessary for all engineers who do advertise to keep outside the jurisdiction of the Michigan courts. This follows from the fact that practically all branches of engineering involve the use of some kind of structure comprising foundation, walls and roof. Power plants, gatehouses for reservoirs, tunnels, subways, filter plants, sewage-pumping stations, standpipes, cranes, etc., are all included, to say nothing of the work *in toto* of structural and mill engineers.

Of course the courts may speedily nullify the law as a whole or such part as is affected by Section 2, but the greater probability is that there will be a progressive interpretation covering only minor points at first, and that later, in perhaps a decade or so, it will be found that the whole scope of the law will be enforced. Engineers can all see what that would mean for them.

Another interesting phase of the matter is the law's relation to both engineers and architects outside the State of Michigan. Much of the work in Michigan is now done by Ohio architects and engineers, who, being outside the state's jurisdiction, do not pay the tax and can use the proscribed letters, words and devices.

In any event the fact that such a law can be enacted without opposition and with no public notice indicates that engineers should actively seek in all states license laws that will put them in position to forestall such a law as this.

It will be further noted that all owners, builders and contractors are exempted from the operation of the law so far as work for themselves is affected. This exemption probably explains why so little publicity was given the bill. All the organized interests being excepted, there was no one to make a fuss, and the engineering profession simply knew nothing of it. Very few know anything of it now.

Provisions of the Law as Enacted

The following are some of the more important provisions of the law:

Section 1. No person shall use the title "architect," or any variation of the same, or use any other words, letters or device to indicate that the person using the same is an architect, after six months subsequent to the passage of this act, without being registered as an architect, in accordance with the provisions of this act. Any person who shall have been engaged in the practice of architecture under the title of architect prior to the time this act takes effect, may secure such certificate in the manner provided by this act.

Section 2. Any person engaged in the business of drawing plans and specifications for the erection, enlargement or alteration of buildings for others, and to be constructed by other persons than themselves, is hereby declared to be an architect within the provisions of this act. The term "building" in this act shall be understood to be a structure, consisting of foundations, walls and roof, with or without other parts; but nothing contained in this act shall be construed to prevent any person, firm or corporation, whether owner, contractor, mechanic or builder, from making plans or specifications for or supervising the erection, enlargement or alteration of any building that is to be constructed by any such person, firm or corporation, or its agents, servants or employees.

Sections 3 to 13 inclusive refer to the appointment and work of an examining board of five members in whose hands the issue of license certificates is placed. The following sections cover the qualifications, nature of examinations, etc.:

Section 14. Any person of legal age and of good moral character, upon the payment of a fee of $10, may apply for examination for registration under this act.

Section 15. The applicant shall satisfactorily pass an examination in such technical and professional courses as are established by the board of examiners.

Section 16. The examination shall have special reference to the planning, design and construction of buildings; the examination shall be in two parts, A and B, as follows: A—Test of the knowledge of the candidate of the strength of materials, construction and architectural design. B—Test of the ability of the candidate to make practical application of the above knowledge in the professional work of an architect, and in the duties of a supervisor of construction of buildings.

Section 17. In lieu of the first part of the examination, A, the board of examiners may accept a diploma of graduation from a recognized college or school of architecture, whose requirements conform to the standard minima of the Association of Collegiate Schools of Architecture.

Section 18. The second part of the examination, B, must be taken by all candidates.

Section 19. In lieu of all examinations the board of examiners shall accept registration or certification as an architect in another state or country where the standard qualifications for the same are not lower than those required by the board of examiners under this act.

Section 20. The board of examiners in lieu of all examination shall accept satisfactory evidence as to the applicant's character, competency and qualifications, and satisfactory evidence that the applicant has been actually engaged in the practice of architecture under the title of architect on his own account or as a member of a reputable firm or association prior to Feb. 5, 1915.

Section 21. The result of every examination or other evidence of qualification, as provided by this act, shall be recorded by the secretary of the board of examiners and the said board shall issue a certificate of registration to every person having passed such examination or as being otherwise qualified to be entitled to receive same.

*Civil Engineer, Jackson, Mich.

Section 24. The board of examiners may revoke any certificate, after 30 days' written notice to the holder thereof and after a hearing before the board of examiners, upon proof that such certificate has been obtained by fraud or misrepresentation, or upon proof that the holder of such certificate has been guilty of malfeasance or gross incompetency in connection with his practice of architecture.

Section 25. Any violation of the provisions of this act shall be a misdemeanor, punishable for the first offense by a fine of not more than $100, and for a subsequent offense by a fine of not more than $500 or imprisonment for not more than one year, or both in the discretion of the court.

Flood-Water Compensator for Low-Head Power Plant

Readers of *Engineering News* are already familiar with the ingenious "fall increaser" invented by Clemens Herschel and described in this journal, Jan. 14, 1915, p. 84. As will be remembered, the object of the "fall increaser" is to supplement the power of a hydraulic turbine at seasons when, on account of high flood stages, the level of the tailwater rises and the effective head on the power plant is reduced.

At the annual meeting of the American Society of Mechanical Engineers last week, Mark A. Replogle, of Akron, Ohio, described a unique hydraulic power plant at the farm and residence of Henry Ford, on the Rouge River, Dearborn, Mich. This power plant contains two turbines designed to develop 85 hp. at the normal head of the stream, which is only 8 ft. The head, however, is subject to great variation. At extreme high water in the Detroit River, into which the Rouge River discharges a little way below the power plant, the tailwater may rise nearly to the level of the top of the dam, when the power plant must of course shut down. Such conditions last only a few hours, but there are periods lasting sometimes for weeks when the head over the dam is only 2 to 5 ft.

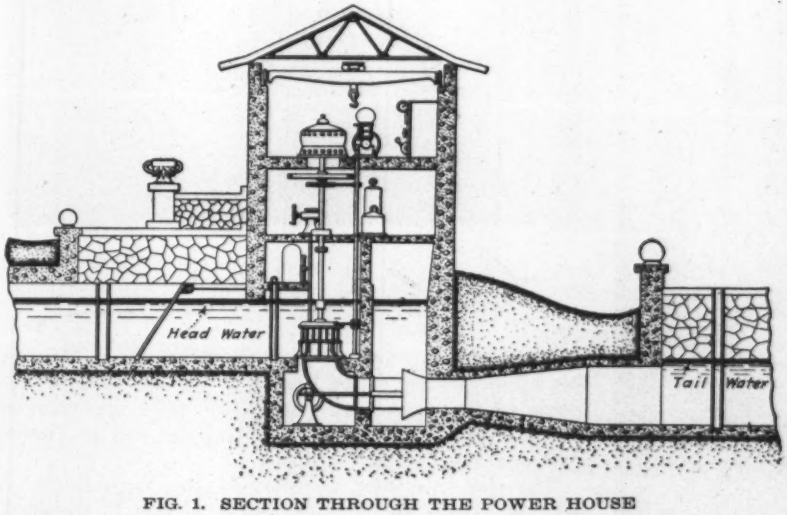


FIG. 1. SECTION THROUGH THE POWER HOUSE

In order to supplement the power of the turbines at times of flood water when the head is reduced, the engineers designed what they term a "discharge accelerator." The purpose of this device, like that of Mr. Herschell's "fall increaser," is to use the power of some of the surplus water to produce a suction on the draft tube of the turbine. In Mr. Herschell's "fall increaser" the principle of the venturi tube is utilized. The suction at the throat of the venturi tube is made to increase the suction in the turbine draft tube. In Mr. Replogle's "discharge accelerator" the principle of the venturi tube is also utilized, but the flood water is discharged in an annular jet around the exterior of the cylinder of water issuing from the draft tube. The accompanying sectional drawing of the power house and the photograph of the turbine, connected draft tube and discharge accelerator set up in the shop will make the operation clear.

FIG. 2. VIEW OF THE COMPENSATOR

Tests on this power plant, made on Mar. 18 last, were described in Mr. Replogle's paper. At the time of the test the head on the turbine was slightly over 8 ft. The turbine was run without the accelerator and developed approximately 90 hp. With the accelerator gate open 20%, the power was increased to about 93 hp., although the head was reduced 2 in. With the accelerator gate open 80%, the turbine developed about 110 hp., although the head was reduced to 7.43 ft. The stage of water in the stream was so low at the time that the accelerator sucked considerable air.

Mr. Replogle's paper did not state whether tests had been made upon the turbine to determine to what extent the accelerator would increase the turbine's power under the conditions of flood water and very low net head on the turbine.

Mr. Replogle's paper, when presented at the meeting, was discussed by Mr. Herschel, who said that he had experimented with a device operating on a somewhat similar principle to the Replogle accelerator before designing his "fall increaser." The efficiency of the apparatus was so poor, however, that he abandoned it. With the "fall increaser" Mr. Herschel found that the flood water falling through the apparatus converted 30% of its theoretical energy to power in the turbine. Where the amount of flood water is limited it should be used with reasonably high efficiency.

News of the Engineering World

New Heads for Philadelphia Engineering Departments

The appointments of five of the six city department heads have been announced by Mayor-Elect Thomas B. Smith of Philadelphia. The new Director of the Department of City Transit is to be announced later.

The Department of Public Works is to be headed by George E. Datesman, for several years Principal Assistant Engineer of the Bureau of Surveys. He was born in West Milton, Penn., in 1863 and was graduated from Lafayette College in civil engineering in 1883. After graduation he spent a year in architectural work in Des Moines, Iowa, and a year as a mining engineer in charge of collieries in Luzerne County, Pennsylvania. Mr. Datesman entered the service of the City of Philadelphia in 1885 as a draftsman. Except for three years (1888 to 1891) he has been continuously with the city engineering department, having served as Chief Draftsman of the Bureau of Surveys and since 1893 as Principal Assistant Engineer.

The new Director of Department of Wharves, Docks and Ferries is to be George S. Webster, now Chief Engineer of the Bureau of Surveys. He was born in Philadelphia in 1855 and was graduated in civil engineering from the University of Pennsylvania in 1875. His early experience was with the Bureau of Surveys, and in 1892, after 10 years' absence in other public work, he was appointed Principal Assistant Engineer of the Bureau.

George S Webster

Geo E Datesman

In 1893 he was promoted to be Chief Engineer. During his administration of the Bureau of Surveys designs were prepared for many public works, the most important of which were perhaps the water-filtration plant at Torresdale and many notable bridges.

The new Assistant Director of the Department of Wharves, Docks and Ferries is to be Joseph F. Hasskarl, a consulting engineer of Philadelphia. He was born in Hazleton, Penn., in 1863, and was graduated from Elmhurst College. He entered the service of the United States Engineer Department in 1883, the same year being made Chief Inspector of harbor work at Philadelphia. He was successively promoted through various grades to be Principal Assistant Engineer in direct charge of Delaware River work. In 1907 he was appointed Assistant Director of the Philadelphia Department of Wharves, Docks and Ferries; in 1909 he was made Acting Director and for a short time after 1911 was Director.

Mechanical Engineers Meet

The thirty-sixth annual meeting of the American Society of Mechanical Engineers was held last week at the Engineering Societies' Building, New York City. It was the most largely attended meeting in the society's history, 803 members and 620 guests being registered. The meeting opened on Tuesday evening with an address by Dr. John A. Brashear, of Pittsburgh, president of the society, on "Science in Its Relation to Engineering." Dr. Brashear's charm as a public speaker attracted an audience that filled the large auditorium. Dr. Brashear has an international reputation as an astronomer and physicist. Discussing the question as to where the line should be drawn between so-called pure science and applied science, Dr. Brashear denied that any such line of demarcation was possible and held that much of the research work carried on merely to add to the fund of scientific information will eventually be found to contribute to the development of some practical art.

Following Dr. Brashear's address, the result of the annual election of officers was announced. The newly elected president is Dr. D. S. Jacobus, for many years professor of experimental engineering at Stevens Institute and more recently consulting engineer of the Babcock & Wilcox Co. The three new vice-presidents are William B. Jackson, of Chicago; J. Sellers Bancroft, of Philadelphia; and Julian Kennedy, of Pittsburgh. The three new managers are John H. Barr and H. de B. Parsons, of New York City, and John A. Stevens, of Lowell, Mass. William H. Wiley was reëlected treasurer. The usual reception by the president and president-elect and other society officers occupied the remainder of the evening.

The annual business meeting of the society was held Wednesday morning. The report of the council showed that the society has made a very rapid growth in membership during the past year, the total membership on Oct. 1 being 6,573. Only three years ago, in 1912, the membership of the society was only 4,000. One factor in the rapid growth of the society has been doubtless the organization in recent years of local sections. Local meetings of the society are now held in 14 different cities in the United States. During the week a conference was held of the secretaries and delegates from local sections with members of the society's council to discuss the methods by which the work of the local sections can be best carried on.

The financial condition of the society is very strong. The total income for the last fiscal year was $147,628, and the total expenses were somewhat over $120,000, leaving a balance of $26,500 for the year, which was added to the society's reserve fund. The society owns property and assets amounting to $722,600, and its outstanding debt is only $54,000. It is noteworthy that of the society's gross income of $147,628 a little less than $89,000 is from the dues paid by members, while nearly $59,000 is from receipts for advertising in the society's publications, from sales of publications, etc., and interest on society funds.

Amendments to the constitution were next taken up. At present any 20 members of the society may constitute themselves an independent nominating committee with the same power to nominate officers of the society as the regular nominating committee. It was proposed to change this requirement so that at least 1% of the voting membership would have to combine in order to make independent nominations. The other amendment proposed that the society copyright its publications. Division of opinion developed as to the wisdom of each of these amendments, and a vote to lay them on the table was carried, the effect of which is to refer them back to the council for further consideration.

Memorial Session for Frederick W. Taylor

At 11 a.m. the regular business was suspended to hold a memorial session in honor of the late Frederick W. Taylor, past-president of the society, who died last spring. Addresses dealing with Mr. Taylor's professional achievements and his fine personality were made by Henry R. Towne, past-president of the society, Henry L. Gantt, vice-president of the society, long associated with Mr. Taylor, and Rear-Admiral Goodrich, of the United States Navy.

Professional Papers at the Meeting

The large number of papers that have been presented at local sectional meetings and that were available for the annual meeting made it necessary to read a number of the papers at the opening session by title only and present other papers in brief abstract.

On Wednesday afternoon three sessions were held simultaneously, one devoted to railway engineering, one devoted to textile engineering, a third to machine-shop practice. On Thursday forenoon two simultaneous sessions were held, one dealing with various papers on power plants and apparatus, the other considering four papers on miscellaneous subjects. At the closing session on Friday forenoon the general subject was "Safety for Workmen in Industrial Plants." The four papers presented dealt with the standardization of safety principles, the attitude of employers and manufacturers toward the safety movement, workmen's compensation laws, and the relation of industrial safety to the principles of shop management. The sessions was well attended and the papers received careful and thorough discussion.

The principal social features of the convention were a "smoker" in the society's rooms on Wednesday evening and a dinner and dance at the Hotel Astor on Thursday evening.

New Haven Electric Line Put Out of Service by Storm

The electrified line of the New York, New Haven & Hartford R.R.—New York to New Haven—sustained the greatest damage in the storm of the night of Dec. 13-14 that it has ever suffered. The storm was most severe between New Rochelle and Stamford, Conn., for 20 to 25 mi. along the main line of the railroad. The heavy transmission line for the electric current and control wires was either burned out or broken in five places between New Rochelle and Bridgeport. Nearly all the masts that carry the telegraph and telephone wires were blown down from the tops of the transmission bridges. The signal wires went down at many points between New York and New Haven, and the signals were put out of service. Over the worst section the snow was reported as 15 in. deep on the level, with drifts 5 to 10 ft. deep, mainly in the cuts.

Four work-trains were sent out from New Haven and New York as soon as they could be manned, and the repair work proceeded as rapidly as possible. A limited number of trains were operated by steam on Dec. 14 between New Haven and Mott Haven. All passenger trains were brought safely into terminals with the exception of one, which was stalled in the snow near Winsted, Conn.

Between Woodlawn and New Haven there are two designs of supporting bridges. The older type was fully described in *Engineering News* of Sept. 5, 1907. The following is a quotation from p. 241:

> In the calculation of these bridges very heavy weather conditions were assumed, and provision was made for clamping the catenary cables on intermediate bridges so that the latter are obliged to partially withstand the longitudinal pull of the cables. It was assumed that the entire system of bridges and cables might become coated with sleet and that this coating might be ½ in. thick around all surfaces. Under these conditions it was assumed that the wind pressure on the bridges and the catenary spans might be as high as 25 lb. per sq.ft.

The later type of transmission construction, as used on the New York, Westchester & Boston Ry. of the New Haven, between Stamford and New Haven is simpler than the old design. In the new construction the supporting bridges for the overhead wires are placed 300 ft. apart.

Improvement to Nashville Water-Works Needed

Improvement to the water-works of Nashville, Tenn., including an addition to the pumping plant and the metering of all consumers, is recommended in a report to the city authorities, made by James C. Cameron, public accountant, New York City, who is conducting an efficiency survey of the municipal departments of Nashville. Associated with Mr. Cameron in his investigation of the physical conditions and operating methods of the water-works were Barclay Parsons & Klapp, consulting engineers, New York City. Mr. Cameron also recommends the employment of a technically trained superintendent and chief engineer of water-works, and improved means of controlling the application of the aluminum sulphate and the hypochlorite of lime used as a coagulant and a disinfectant respectively.

Alternative plans for increasing the capacity of the pumping plant are recommended to the consideration of the city authorities. The first plan provides for a 20,000,000-gal. steam pump and various minor accessories at the present pumping station, at a total estimated cost of $209,000, and at an operating and capital expense of $90,908. The second plan contemplates placing three 7,500,000-gal. centrifugal pumps with motors in the water-works pumping station, these pumps to be operated with power from the electric-lighting plant. The cost of this plant would be $111,550, including some new boilers and a new turbo-generating unit in the lighting plant. The annual operating and capital charges for the second plant would be $72,778.

A strong recommendation for metering every water-works service is made. It is estimated that this would cost from $50,000 to $60,000, as on Sept. 30, 1915, there were 16,271 meters out of a total of 19,779 connections, leaving only 3,508 taps unmetered.

A question is raised as to whether or not the water-works intake, which now extends a short distance into the main current of the Cumberland River below the outlet of Mill Creek, should not be removed upstream 2,000 to 3,000 ft. in order to avoid contamination from Mill Creek, which is polluted by the discharge of sewage from the State Insane Asylum. A rough estimate of the cost of the extension of the intake is $70,000 to $100,000.

Attention is called to the fact that the distribution system includes a considerable number of old cast-iron pipe cast on its side, and therefore very thin on one side. A progressive replacement of this pipe is advised.

To facilitate cleaning the large reservoir that serves as a settling and coagulating basin, the subdivision into two equal parts of one of the two existing basins is recommended.

First Meeting of the American Association of Engineers

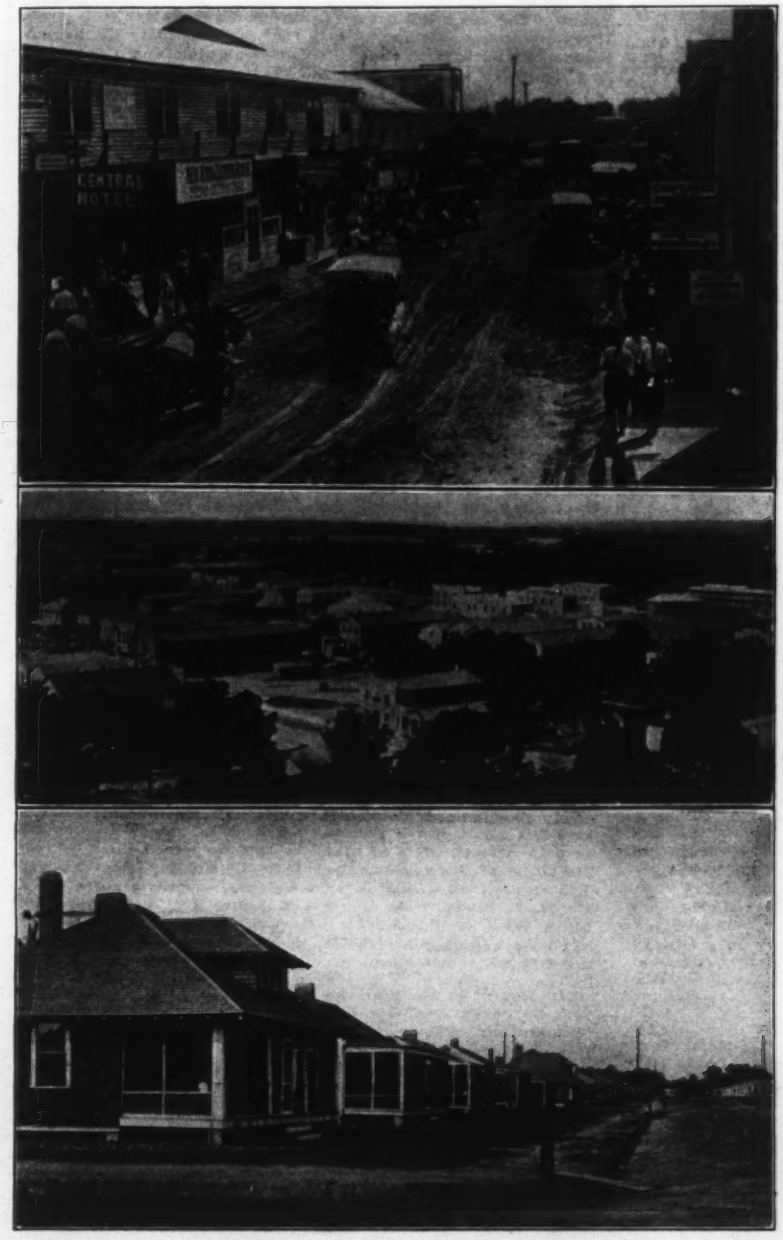
The American Association of Engineers is a new society, whose objects are to raise the standard of ethics and to promote the economic and social welfare of engineers, rather than to deal with technical matters. Its first convention was held Dec. 10 and 11 at the La Salle Hotel, Chicago. The total registration was over 400, though the attendance at the sessions was small (except at the Saturday afternoon session). The society was welcomed by H. S. Baker, Assistant City Engineer, and the opening address was then delivered by the president, W. D. Wilcox (gas engineer), of Chicago. Prof. F. H. Newell, University of Illinois, discussed at some length the desirability of coöperation for improving the position of the engineer and securing proper recognition of the importance of both engineering and the engineer.

A report on the work of the association was presented by the secretary, Arthur Kneisel (patent attorney), Chicago. The work so far has been mainly in the direction of securing employment for engineers, and the results were said to have been very satisfactory. The greater part of one session was devoted to a general discussion of the aims and purposes of the association, and very diverse opinions were presented on certain features, more especially as to the advisability of requiring (as at present) that members must be citizens or at least have declared their intentions to become citizens. On the one hand, it was claimed that membership should be open to anyone having the professional qualifications, regardless of other conditions. On the other hand, it was urged that the association is for the benefit of American engineers and that those who desire to avail themselves of its assistance should at least have shown their intention to become Americans.

This discussion was opened with a paper on "Qualifications," by T. B. Lambert, power engineer of the Chicago Telephone Co. Among the other papers were "Relation of Patent Rights to the Engineer," by G. Willard Rich, patent attorney, Rochester, N. Y.; and "The Economic Aspects of Engineering Pay," by J. H. Prior, Chief Engineer of the Illinois Public Utilities Commission. A dinner was given Dec. 10. At the afternoon session on Dec. 11 the Chicago Telephone Co. had an exhibit of moving pictures, illustrating its activities. The association has now a membership of about 300.

Fire Destroys Infant City

The greater part of the new city of Hopewell, Va., was destroyed by a fire on Dec. 9. Practically all of the main section, that is, the part shown in the middle of the accompanying three views, was in the path of the flames, but two of the adjoining residence districts, known as A Village and B Village, a street of one of which is shown in the lowest of the three views, were saved.



HOPEWELL, VA., BEFORE THE FIRE OF DEC. 9

Upper View—Looking down main business street toward railway station. Middle View—The section which was destroyed. Lower View—A street in B Village

A little more than two years ago the Du Pont Powder Co. opened on the point of land between the Appomattox and the James Rivers, about 12 mi. from Petersburg and 30 mi. down the James River from Richmond, Va., a dynamite plant, in which manufacturing was started on a very small scale. This plant was shut down at the outbreak of the present European war. Somewhat less than a year ago, however, the site was reoccupied, this time for a gun-cotton and sulphuric-acid plant, the latter reported to be the largest in the world.

The details of this new plant are not available. It is fenced around with a high barbed-wire barricade, and visitors are not welcome. There are, however, working in this plant some 18,000 men. It became necessary therefore to provide in a district which up to last April was given over to cornfields and peanut rows living quarters for most of these workmen and their families, together with the necessary adjuncts, such as stores, hotels and restaurants. The city of Hopewell is the result.

The upper view on this page illustrates very well the type of city, a type hitherto unknown to the East and to the present day, but common enough in the Western gold and silver camps of a generation or more ago. Beginning as an aggregation of shacks and tents with a large and active lawless element, Hopewell during the past summer developed into an approximation of an orderly city. Streets were laid out, sewers and water mains were built, electric lighting was installed, and a semblance of a city government was set up, under the direction of the county judge. In the coming legislature a city charter is to be asked for. At the time of the fire there were probably resident in this district at least 35,000 people. Two months ago there were only 20 voters in the place. There were no more who had lived there a sufficient length of time to obtain the local franchise.

The Du Pont company's plant embraces about 3,200 acres. The town of Hopewell spreads over about 500 acres, on a length of approximately 6 mi. and an average width of half a mile. The business section surrounded the Norfolk & Western R.R. station and was made up mostly of one- and two-story shacks, but within the past month or so a number of two- and three-story brick buildings had been built. Practically all of these, the brick as well as the timber, were destroyed by the fire, which started in a restaurant along the street shown in the upper view. In the outlying districts the Du Pont company had built two residence cities. These were laid out in rectangular squares and the lots portioned off in such a fashion that each house would have a sufficient amount of air space surrounding it. On these lots a number of similar houses were built, mostly of the made-to-order style, in which the timber

is shipped to the site all cut and matched ready to erect. A Village is composed of nearly 200 houses, and B Village of about 400 completed houses and 300 unfinished houses. Both were seriously threatened by the fire, but the efforts of the residents managed to save them.

Conflagration risks in the main part of Hopewell were of course as bad as possible. While the Du Pont company had installed sufficient fire protection for its plant, the town had only one inadequate fire engine, and the water-supply was in itself quite limited. A strenuous effort had been made to emphasize the need for individual fire extinguishers; but the restaurant in which the fire started was not so equipped, and the others were of course quite worthless in putting out the conflagration itself.

It is reported that the citizens of Hopewell are immediately going to work to rebuild the burned city. The gun-cotton and acid plant is working under its usual forced draft, and it of necessity requires men who must live near-by. Petersburg is connected to the plant by a single-track line of the Norfolk & Western R.R., which is now being double-tracked, and will be connected early in the coming year by an electric interurban line now nearing completion. The road between Petersburg and Hopewell, the only other land approach, is probably the worst road in the world.

Big Oil-Storage Depot Completed—A storage and distributing depot to take care of 500,000 bbl. of bulk and package oil was recently completed at Point Wells, near Seattle, Wash., to handle the Northwest and Alaska trade of the Standard Oil Co. The fire-protection system is of the Irwin foam type described in "Engineering News" of Aug. 20, 1914. The system as worked out for Seattle employs two tanks, one containing sodium carbonate, glue and carbolic acid, the other containing aluminum sulphate and sulphuric acid. Four-inch pipes connect the chemical tanks with the oil tanks; the mixing of the chemicals named, which happens when fusible plugs melt in burning tanks, produces a thick foam that covers the surface of the oil and smothers the fire. The plant covers 20 acres of filled land on the shore 15 mi. north of the city. There are 33 storage tanks, which include 14 lubricating-oil tanks and 4 fuel-oil tanks; the latter are of 55,000-gal. capacity each. The plant has its own electric power and lighting system and its water system. Power is furnished from a hydro-electric station situated in the hills. A concrete sea wall 1,000 ft. long fronts the plant, and beyond is a pier 550 ft. long and 50 ft. wide, with low water 40 ft. deep. The plant has two approaches to the pier. In its Northwest and Alaska trade the company's Seattle head quarters, in August, 1915 (an average month), distributed 181,600 bbl. of oil.

Municipal Ownership of Water-Works at Chattanooga, Tenn., has been delayed by a Chancery Court decision on a technical point. The decision, if upheld on appeal, ousts the water-works commission and holds void a bond issue for the purchase of the property of the City Water-Works Co. The city is planning to acquire the property by some other means.

PERSONALS

Mr. Thomas A. Bither, M. Am. Soc. C. E., a member of the City Engineer's staff of Berkeley, Calif., has been appointed Superintendent of Streets of that city.

Mr. Walter Anderson, City Engineer of Centralia, Wash., has resigned to accept a position with the Berger Manufacturing Co., Canton, Ohio, at Minneapolis, Minn.

Mr. Edwin Jennings has opened an office as consulting engineer at 835 Broadway, New York City. He was formerly Chief Engineer of a bridge works and for 12 years was with the Department of Bridges of New York City.

Mr. R. W. Creuzbaur, M. Am. Soc. C. E., has been appointed Consulting Engineer for the City of Elizabeth, N. J., on the railway improvements of the Central R.R. of New Jersey between Newark Bay and the city limits. The grade separation and other changes are to be considered by the State Public Utilities Commission early in January. The proposed work involves an expenditure of $4,000,000.

Mr. F. Peiter has resigned as Coke Oven Engineer with the Gas Machinery Co., Cleveland, Ohio. For the past three years Mr. Peiter has been engaged in the designing and development of the gas machinery top-burner regenerative coke oven. Previous to his association with the Gas Machinery Co. he was connected with H. Kopper Co. as Designing and Constructing Engineer and was with the Tennessee Coal and Iron Co. during the designing and construction of the Corey coke-oven plant.

Mr. Oscar S. Straus, former Secretary of the Department of Commerce and Labor, has been appointed Chairman of the Public Service Commission, New York, First District, to succeed Mr. Edward E. McCall, whose removal was noted in the personal columns of last week. Mr. Straus was born in Bavaria in 1850. His father emigrated to this country two years later. Mr. Straus is a graduate of Columbia University and of Columbia Law School. He was twice Minister to Turkey, and has been long prominent in public affairs.

Mr. F. L. Stockburger, whose name was on the certified civil service list, has been appointed Superintendent of the municipal garbage-reduction works of Cleveland, Ohio, succeeding Mr. Fred W. Cummings, who resigned a few months ago to take a position with a privately owned garbage-reduction plant in Detroit. Mr. Stockburger was at one time in the employ of the private company which disposed of the garbage of Toledo, Ohio, by reduction, and when appointed to his new position in Cleveland was acting as contract clerk for that city.

Messrs. Frederick P. Stearns, William Mulholland and R. H. Thomson, M. Am. Soc. C. E., have been appointed a commission to investigate the seepage problem at the Cedar Lake reservoir (Seattle) water-supply, described in "Engineering News," Nov. 25, 1915, p. 1053. Mr. Stearns is a consulting engineer of Boston, Mass., and was formerly Chief Engineer of the Metropolitan Water-Works of Massachusetts. Mr. Mulholland is Chief Engineer of Public Service, Los Angeles, Calif., and was formerly Chief Engineer of the Los Angeles aqueduct. Mr. Thompson was for many years City Engineer of Seattle.

Mr. W. H. Williams, Vice-President of the Delaware & Hudson Co., has been elected Chairman of the Board of Directors and Chairman of the Executive Committee of the newly reorganized Wabash R.R. He will continue his work as Vice-President of the Delaware & Hudson. Mr. Williams was born in Athens, Ohio, in 1874. In 1891 he joined the engineering corps of the Pittsburgh & Lake Erie R.R. Later he went into clerical work, and in 1896 was made private secretary to Mr. L. F. Loree, then General Manager of the Pennsylvania Lines West of Pittsburgh. Most of the time since then he has been associated with Mr. Loree, who is now President of the Delaware & Hudson.

Mr. Robert B. Marshall, M. Am. Soc. C. E., Chief Geographer, United States Geological Survey, has been appointed General Superintendent of National Parks, to succeed Mr. Mark Daniels, who has resigned to engage in private business. Mr. Marshall was formerly a topographer in the Geological Survey and since 1908 has been Chief Geographer. In 1904 he was a member of the Yosemite National Park Commission constituted to consider changing the boundaries of the park. In 1911 he was designated by the Secretary of State head of the American delegation to the Tenth International Congress of Geography. In 1911, 1912 and 1915 he was a member of the National Park Conferences.

Mr. O. E. Carr, City Manager of Cadillac, Mich., has been appointed City Manager of Niagara Falls, N. Y., effective Jan. 1, 1916. His salary will be $5,000 per annum. Mr. Carr was graduated from Allegheny College in civil engineering in 1900. For several years he was with the United States Coast and Geodetic Survey and later with the Baltimore & Ohio R.R. His experience in municipal engineering work was gained in Pittsburgh, Seattle, and Portland, Ore., and Cincinnati. He was appointed City Manager of Cadillac in 1914, being at that time Engineer in charge of underground surveys, division of sewers, at Cincinnati. There were 13 applicants for the position at Niagara Falls—only one of which was from a local man. The vote of the city council for Mr. Carr is reported to have been unanimous.

OBITUARY

S. H. Berry, County Engineer, Kitsap County, Washington, died at his home in Port Orchard, Nov. 26.

Charles W. Lord, of the civil engineering department of the New York, New Haven & Hartford R.R. Co., died Dec. 11 at New Haven, Conn. Mr. Lord was 50 years old and had been in the company's employ for 26 years.

Edward Rathbone Beacon, Vice-President of the Baltimore & Ohio Southwestern R.R., died Dec. 2 at the Johns Hopkins Hospital in Baltimore, Md., from appendicitis. He was born in New York City in 1846 and was educated as a lawyer.

Peter Joseph Flanagan, who for more than 20 years was foreman of the Bureau of Maintenance of the Department of Highways, Borough of the Bronx, New York City, died at his home in that city, Dec. 11, at 74 years of age. He was a native of Ireland.

Alfred M. Wiles, a manufacturer of brick machinery for 60 years, died Dec. 12 at his home in Stony Point, N. Y., at 87 years of age. At the time of his death Mr. Niles was President of the A. M. & W. H. Wiles Co., at Grassy Point, N. Y. Mr. Wiles was born in England.

Ward Crosby, Chief Engineer of the Carolina, Clinchfield & Ohio Ry., Johnson City, Tenn., died recently. He was born in Canada in 1859 and entered the railway service in 1880. He was a transitman for three years on the location of the Mexican Central R.R., and later Assistant Engineer of the Boston & Lowell R.R. and its successor, the Boston & Maine R.R. He went to the Carolina, Clinchfield & Ohio R.R. as Assistant Engineer in 1891, and was successively promoted to be Division Engineer, Principal Assistant Engineer and, in 1911, Chief Engineer.

Lieut.-Col. Charles S. Bromwell, Corps of Engineers, U. S. A., in charge of works for defense of Honolulu and Pearl Harbors and other work in the Hawaiian Islands, committed suicide Dec. 10 at Honolulu. He was 46 years old and a native of Kentucky. He was graduated from the United States Military Academy at West Point in 1890. He had charge of Mississippi River work at New Orleans and Vicksburg, Miss., in 1902 and 1903 and subsequently was in charge of the Office of Public Buildings and Grounds, at Washington, D. C. His last work before going to Honolulu was at Cleveland, Ohio, where he spent two years in charge of the Cleveland district of the War Department work. His most notable achievement in Cleveland was the bringing together of the various conflicting interests in the Cuyahoga River straightening and harbor-line projects, so that the concerted plan which is now being worked out under Maj. P. S. Bond, Corps of Engineers, U. S. A., could be agreed upon.

ENGINEERING SOCIETIES

COMING MEETINGS

SECOND PAN-AMERICAN SCIENTIFIC CONGRESS.
Dec. 27-Jan. 8. Washington, D. C.

OKLAHOMA SOCIETY OF ENGINEERS.
Dec. 28. Annual meeting in Oklahoma City. Secy., H. V. Hinckley, Oklahoma City, Okla.

AMERICAN CIVIC ASSOCIATION.
Dec. 28-31. Annual convention in Washington, D. C. Secy., R. B. Watrous, Union Trust Bldg., Washington, D. C.

SOCIETY OF CONSTRUCTORS OF FEDERAL BUILDINGS.
Jan. 3-6. Seventh annual convention in Washington, D. C. Secy., C. R. Marsh, Brattleboro, Vt.

CENTRAL RAILWAY CLUB.
Jan. 14. Annual meeeting in Buffalo, N. Y. Secy., H. D. Vought, 95 Liberty St., New York City.

MONTANA INSTITUTE OF MUNICIPAL ENGINEERS.
Jan. 17-19. Annual meeting at Billings, Mont. Secy., C. C. Widener, Bozeman, Mont.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Jan. 18. Annual meeting in Pittsburgh. Secy., E. K. Hiles, 2511 Oliver Building, Pittsburgh, Penn.

KANSAS ENGINEERING SOCIETY.
Jan. 18-19. Annual meeting at Kansas State Agricultural College. Secy., C. A. Foster, Topeka, Kan.

THE FRANKLIN INSTITUTE.
Jan. 19. Annual meeting in Philadelphia. Secy., R. B. Owens, Philadelphia, Penn.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 19-20. Annual meeting in New York City. Secy., C. W. Hunt.

NATIONAL DRAINAGE CONGRESS.
Jan. 19-21. Annual meeting, Cairo, Ill. Vice-Pres., Edmund T. Perkins, First National Bank Building, Chicago, Ill.

NATIONAL SOCIETY FOR THE PROMOTION OF INDUSTRIAL EDUCATION.
Jan. 20-22. Annual convention in Minneapolis. Secy., Alvin E. Dodd, 140 West 42nd St., New York City.

ILLINOIS CHAPTER: AMERICAN WATER-WORKS ASSOCIATION.
Jan. 25-27. Annual meeting, University of Illinois, Urbana. Secy., Dr. Edward Bartow, Urbana, Ill.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.
Jan. 26-28. Annual meeting, University of Illinois, Urbana, Ill. Secy., E. E. R. Tratman, Wheaton, Ill.

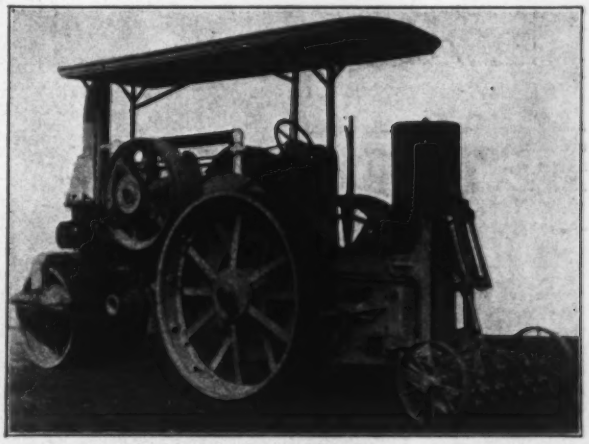
An Iowa Section of the American Water-Works Association was organized at a meeting held in Iowa City, Dec. 3-4. There were 69 registered at this meeting, including members and guests. The following officers were elected: Chairman, Robert N. Kinnaird, chief engineer, Des Moines Water Co.; vice-chairman, C. H. Streeter, Cedar Falls Water and Electric Co.; secretary, Jack J. Hinman, of the State Board of Health, Iowa City; directors, William Molis and J. P. Berry. There are 33 active members of the American Water-Works Association in Iowa.

New England Water-Works Association—The usual monthly meeting was held in Boston, Dec. 8. A paper by Caleb M. Saville, Chief Engineer, Hartford Water-Works, described certain phases of the new supply being developed and gave some interesting water-consumption figures. Some notes from this paper appear elsewhere in this issue. A second paper, on "The Middleboro Reinforced-Concrete Tower Tank," was read by G. A. Sampson, of Boston. This 500,000-gal. 165-ft. structure was described and illustrated in "Engineering News" of Aug. 26, 1915, p. 392.

Appliances and Materials

Power-Operated Road Scarifier

A scarifier attachment for steam or gasoline road rollers, which is operated by steam or compressed air, is a recent development in road machinery. The scarifier may be attached either to a three-wheel or a tandem roller. A unit frame contains the scarifier, carrying two heavy steel rocking shafts, an oscillating cylinder, piston and rod, crosshead fork and individual scarifier beams or arms. The roller operator controls the depth of cut by air or steam pressure. The pressure is applied by means of a double-acting swinging cylinder, the reverse action being provided to lift the teeth quickly from the ground. The cylinder pressure is also designed to insure such elasticity that the teeth will dig to a uniform depth on the roughest surfaces and save broken teeth when running over solid rock. The ordinary width of the scarifier is 6 ft., the same as that of the road roller, but the scarifier width may be varied by the operator, because each tooth is on a separate arm. This device has been successfully used for the toughest kind of scarifying, including ripping up of city pavements. It is made by the Kelly-Springfield Road Roller Co., Springfield, Ohio.



POWER-OPERATED SCARIFIER ATTACHMENT

* * *

Piston Valve for Air Compressors

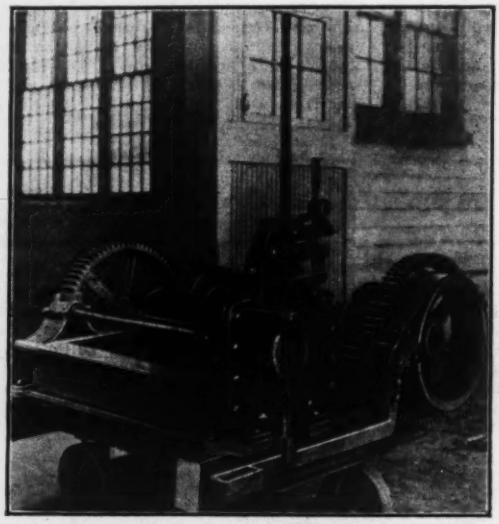
A balanced piston valve for steam-driven air compressors has been developed by the Ingersoll-Rand Co., of New York City. This valve is intended to replace the slide valve used

on compressors below the sizes where the Corliss valve-gear becomes practicable. (The slide valve has given trouble with high pressures and superheats, due to warping, leakage and defective lubrication.) Steam is admitted through the center of the (hollow) piston valve, and the cutoff valves for head- and crank-end ports are inside the piston. The position of these cutoff valves is shifted by turning the cutoff-valve stem, the valves being engaged by right- and left-hand threads on the stem. The chest covers and steam packings are subjected to exhaust steam only. Rotation of the auxiliary steam is effected by a chain-driven oil pump working against a weighted plunger. Both changing speed and changing air pressure affect the cutoff. Constant speed is maintained against changing steam pressure, but variation in demand for air shifts the steady running speed.

* * *

Automatic Brake for Hoisting Engines

The hoisting engine shown in the view has the long vertical hand lever connected by links to the brake pedal or foot lever and to the throttle valve, so that when the throttle is closed the brake is applied automatically. This results in a cushioning effect upon the machine when the



HOISTING ENGINE WITH AUTOMATIC BRAKE

boom is moving and tends to eliminate the danger of breaking gears and pinions when it is desired to stop the boom with the heavy load on the machine. This device has been developed by the Dake Engine Co., of Grand Haven, Mich., and is being applied to its various types of hoisting engines.

* * *

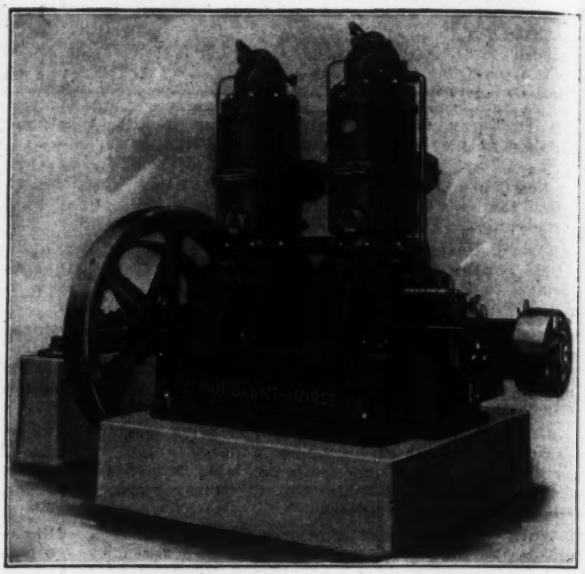
Weather-Forecasting Barometer

A recording aneroid-type barometer has been developed by the Taylor Instrument Co., of Rochester, N. Y., for warning of weather changes. This has been given the trade name "Cyclo Stormograph." Movement of the pressure chamber is communicated to a pen arm and a record is made on a paper chart wrapped about a clock-driven cylinder. The main chart divisions instead of showing pressure lines give lettered sections, A-B, B-C, C-D, etc., to I-J. An explanatory card tells the user, for example, that a falling line in the B-C section means "fair and warmer followed by wind and rain"; in H-I means "stormy weather," and in I-J "hurricane, gale or tornado." A rising line, the card shows, in I-H means "increasing winds followed by colder weather" and in C-B "clear tonight and continued cool with moderate winds."

* * *

Semi-Diesel Oil Engine

A new oil engine of the "semi-Diesel" type, designed to use any grade of crude oil or distillate, is being introduced by Fairbanks, Morse & Co., of Chicago, and is shown in the accompanying view. It is built in sizes up to 25 hp. for horizontal (single-cylinder) and up to 100 hp. for vertical (double-cylinder) engines. There are no valves, the piston covering and uncovering the ports. Crankcase compression not exceeding 2 lb. is used for scavenging and recharging. To save time in starting the engine when cold, a kerosene torch is used to heat an auxiliary starting tube which projects through the wall of the combustion chamber, so that it is



NEW VERTICAL CRUDE-OIL ENGINE

not necessary to bring the walls of this chamber to the ignition temperature before starting. The combustion chamber is waterjacketed like the cylinder.

The oil is injected by a pump driven through a rocking shaft by means of an eccentric on the main shaft. The amount of oil consumed is varied automatically to suit the requirements of the load, being regulated by the inertia governor on the shaft, which changes the position of the eccentric and therefore the length of stroke of the pump. Oil from the main storage tank is delivered by a small pump to an auxiliary reservoir above the main pump, and there is another pump for force-feed lubrication of the cylinder. The main bearings are of the ring-oiling type, with large reservoirs. A special air-seal ring around the bearings in the crankcase prevents the compression of the entering charge of air from interfering with the lubrication.

* * *

New Hand-Hammer Air Drill

A novel design of hand-hammer type of small air drill has been completed by the Chicago Pneumatic Tool Co., Chicago. This has been given the trade name "Hummer Drill." The drill chuck is geared to a shaft parallel to the cylinder and driven through a worm by a simple high-speed rotary air engine. The exhaust goes to the valve chamber of the hammer cylinder. The parts have been kept few and simple. The motor is between the handle and the cylinder. Rotation is always in one direction and no ratchet is used. The valve for the hammer piston is a ¾-in. steel ball with a movement of about ⅛ in. between seats. A throttle valve on the exhaust softens the hammer blow and sends air through the steels (hollow) to clean out the hole. Three sizes are available: The A-66 weighs 40 lb. and bores a ⅞-in. hole 6 ft. deep; the B-66 weighs 55 lb. and drills a 1-in. hole 8 ft.; and C-66 weighs 65 lb. and drills a 1⅛-in. hole 12 ft. All sizes may be column or tripod mounted if desired. All have a 2½-in. cylinder, but the strokes are 2½, 2¾ and 4¾ in. respectively.

NEW 40-LB. HAND DRILL

Engineering News

VOLUME 74 DECEMBER 23, 1915 NUMBER 26

Pike's Peak Highway, Colorado

By R. C. Hardman*

What is claimed to be the world's highest automobile highway has recently been completed from Cascade, Colo., to the summit of Pike's Peak. Pike's Peak, which attains an elevation of 14,109 ft. above sea level, is perhaps the best known and most visited mountain in the United States. Although there are some 26 mountains and peaks in Colorado alone which are higher than Pike's, it, by virtue of its dominant position in the Rampart Range and its easy accessibility, ranks first in the mind of the tourist. Since the construction of an Abt-system cog railway (Manitou & Pike's Peak R.R.) in 1891 thousands of tourists have made the ascent to the summit, from which it is said some 60,000 sq.mi. of the State of Colorado can be seen. A makeshift carriage road has also been available for a number of years, but only very few automobiles have been able to reach the top.

The Peak is located about 14 mi. west of Colorado Springs. The base of the Peak is at Manitou, about 6 mi. northwest of Colorado Springs, the cities being connected by an electric railway. The ascent of the Peak is made from Manitou by cograil railway or burro. The cog road is approximately 9 mi. long, having an average grade of about 16%, with a maximum of 25%.

FIG. 1. VIEW LOOKING OVER A PART OF THE PIKE'S PEAK HIGHWAY

*Civil Engineer, Colorado Springs, Colo.

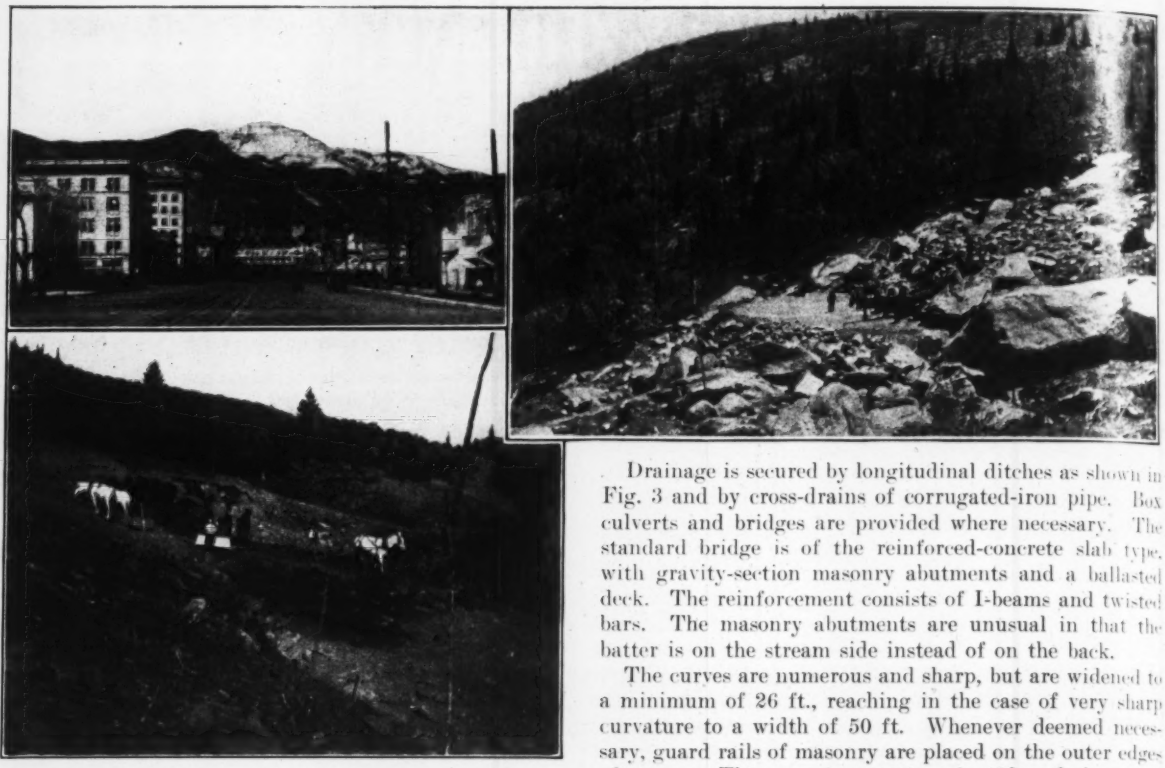


FIG. 2. PIKE'S PEAK FROM COLORADO SPRINGS: CONSTRUCTION VIEWS OF NEW AUTOMOBILE HIGHWAY

About a year ago a company was organized to construct and operate a toll road to the summit. The most feasible route was found to be that of the old carriage road which branches off the Ute Pass state highway at Cascade, about 12 mi. northwest of Colorado Springs in the historic Ute Pass, on Fontaine qui Bouille Creek. Surveys were made early last spring, and the construction work followed closely. The line of the old carriage road was followed in general, although the new line was relocated throughout its entire length, attention being given to the scenic possibilities. Typical of mountain highways, it abounds in sharp curves and steep grades.

Starting from Cascade at an elevation of 7,415 ft., the new road reaches the summit of the Peak in 17.9 mi., rising in elevation 6,694 ft. The road first climbs Cascade Mountain, following Cascade and Crystal Creeks, then traverses Crystal Creek plateau, skirts the Rampart Range, the crest of which is reached at about Mile 15. From there to the Peak, 2.9 mi., the road rises from El. 12,970 to El. 14,109. The timber line is reached at about Mile 12 at El. 11,880.

The engineering features, while not unusual, differ in many ways from the older mountain roads of Colorado, many of which are not wide enough for two vehicles except at intervals where turnouts are provided. The standard width of roadway adopted is 20 ft., of which 3 ft. is used as a shoulder and to form a shallow drainage ditch for all cross-sections except on embankments. On embankments the roadway cross-section is a parabolic curve with a crown of 0.3 ft. On sidehill cut-and-fill cross-sections the surface has a transverse slope of 1 in 40. Typical cross-sections are shown in Fig. 3.

Drainage is secured by longitudinal ditches as shown in Fig. 3 and by cross-drains of corrugated-iron pipe. Box culverts and bridges are provided where necessary. The standard bridge is of the reinforced-concrete slab type, with gravity-section masonry abutments and a ballasted deck. The reinforcement consists of I-beams and twisted bars. The masonry abutments are unusual in that the batter is on the stream side instead of on the back.

The curves are numerous and sharp, but are widened to a minimum of 26 ft., reaching in the case of very sharp curvature to a width of 50 ft. Whenever deemed necessary, guard rails of masonry are placed on the outer edges of curves. The average curvature is 40° and the maximum is 96°. On several of the sharper curves where it was not feasible to use the standard cross-sections, special cross-sections were designed. One of these, at the summit, is shown in Fig. 3. The extremely crooked alignment of the road is shown in Fig. 4. To further show the method of handling the "switchbacks" necessary to make the climb in Miles 14 and 18 enlarged plans are given in Figs. 5 and 6. In Mile 14 an elevation of 455 ft. is overcome. The average grade of the highway is a trifle over 7%.

The maximum grade is 10%. There are few adverse grades. Fig. 7 shows a condensed profile, with the vertical scale ten times the horizontal. The elevations at the mile posts only are used in making this profile, so that the grades shown are average and not the steepest.

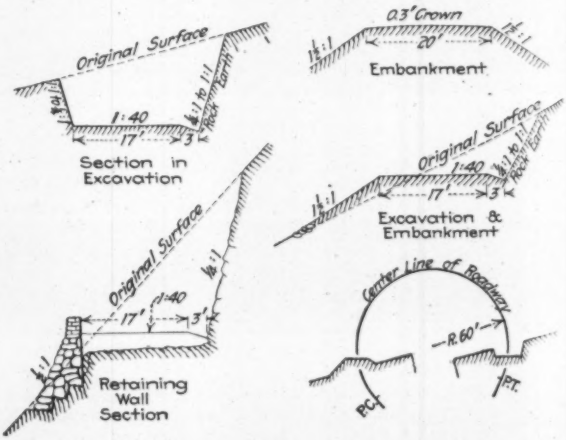


FIG. 3. TYPICAL SECTIONS IN CUT AT RETAINING WALL AND SECTIONS AT THE SUMMIT LOOP

Automobile supply stations are provided along the road. One of these is located at Toll Gate, one at Glen Cove and a third at the summit of the Peak. Water-supply tanks and hose are located as shown on the plan, Fig. 4. A telephone line 12½ mi. in length also reaches from Cascade to the top. The company which built the road

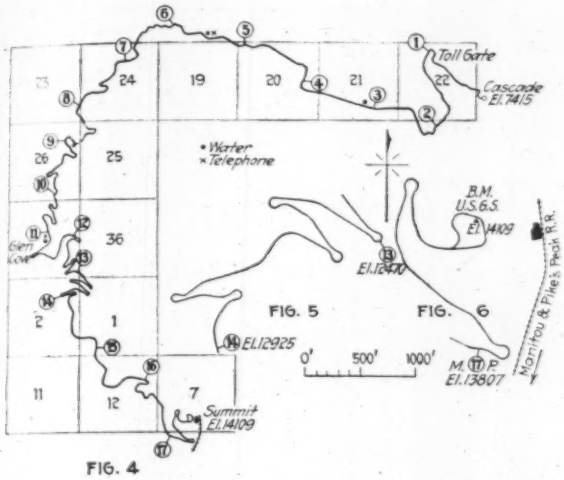


FIG. 4

FIGS. 4, 5 AND 6. PLAN OF PIKE'S PEAK AUTOMOBILE TOLL ROAD AND PLANS OF MILES 14 AND 18

operates a number of tourist motor cars. Privately owned cars are also allowed to use the road on payment of toll.

The photographs show the country through which the highway is built, although due to the lack of perspective full justice is not done the magnificent scenery. The material of which the road is built, in common with that of all the Pike's Peak region, is mostly granite and disintegrated granite. In some places a light surface soil was encountered. No special difficulty in construction was experienced, although part of the road is in a region

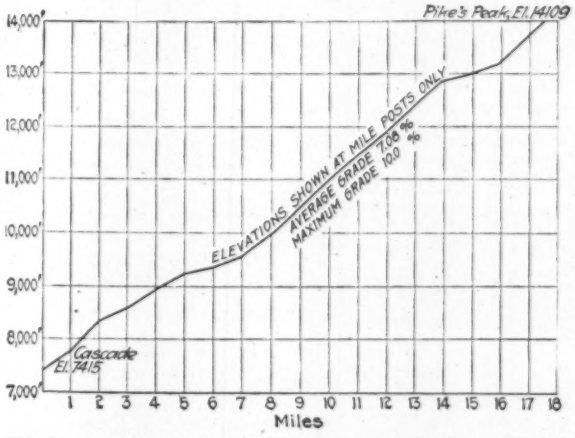


FIG. 7. CONDENSED PROFILE OF PIKE'S PEAK HIGHWAY

of perpetual snow. No power machinery was used for grading. The material was moved by hand shoveling, slip, fresno and wagon, as is usual in the West.

The originator and proprietor of the road is E. A. Sunderlin, of Colorado Springs, Colo. The location and design were under the direction of A. G. Allan, of Denver, as Chief Engineer. The writer wishes to acknowledge the courtesy of N. L. Drew, of the company, in furnishing much of the data given.

Sewage Disposal at Detroit

The problem of sewage disposal at Detroit, to eliminate the present pollution of the Detroit River, is complicated by the fact of the river being an international stream, the prevention of the pollution of which is under investigation by an International Joint Commission. In December, 1914, Clarence W. Hubbell, consulting engineer, was appointed by the city to investigate the problem and make recommendations for its solution. His work is being carried on independently of but in close relation with that of the commission.

For some years past Detroit has been growing at a more rapid rate than any other city in the United States. It has now a population of about 480,000, including immediate suburbs, and it is estimated that it will reach 1,500,000 in the 1935-45 decade. It has the combined system of sewers, with numerous outlets along the river. In this way it pollutes the water of several lower towns.

The city water-works intake is just above the upper sewer outfall, at the Fairview sewage-pumping plant, which is to be enlarged. But the water is already polluted by villages and towns higher up along the shore of Lake St. Clair. Some of these places are building sewerage systems (on the separate plan), and by agreement with them the city has built and expects to extend an intercepting sewer near the shore line to protect the city's water-supply. The water is treated by hypochlorite, but this is to be changed to liquid chlorine.

The highest pollution is below the city on the American side (max. 100,000 B. coli per 100 c.c.), a lower pollution (max. 10,000) on the Canadian side, and relatively low pollution (4 to 10) in the middle of the stream, except that occasional high records (100 or more) in the middle indicate pollution from ships.

The general plan will include large areas that can be successfully handled only by establishing a sanitary district or by extending the city limits to include rapidly developing suburbs. The conversion of the city's sewers from the combined to the separate system will not be recommended except where feasible in new territory. Tentative plans provide for the construction of intercepting sewers to handle the sewage proper and deliver it to treating plants (probably Imhoff tanks or screens, combined with disinfection). Industrial wastes do not present any serious difficulties except that grease and gasoline from the large automobile factories constitute a special problem, and means must be taken to prevent explosions in the sewers and pumping stations.

The instructions issued by George H. Fenkel, Commissioner of Public Works, to Mr. Hubbell cover three principal points: (1) To review the data and conclusions of the International Joint Commission for the purpose of enlarging on any phase of the matter necessary in order to determine what preventive or remedial measures are required with reference to Canadian waters. (2) To what extent does the Detroit sewage pollute American waters so as to render them unfit as a source of raw water for filtration purposes? (3) The means which the city should undertake to purify the sewage, and what expense would be justifiable for that purpose.

The report will be broad and comprehensive, giving general plans, estimates and recommendations, but leaving the preparation of detail plans until action has been taken on the general recommendations.

Sand and Gravel Washing and Grading Plant

By C. B. Breed*

The use of gravel for concrete is well established, and as pit gravel contains usually an excess of sand, it is now general practice to clean and grade these materials by screening and washing. An advantage to the contractor is that the gravel and sand can be shipped from the same pit, so that there is less liability of delay or interruption in the supply of concrete material.

A sand and gravel washing plant recently built at Lynnfield, Mass., is shown in Fig. 1. This has a capacity of handling 800 cu.yd. of pit gravel per 8-hr. day. The material is excavated by means of a dragline cableway with a 2-yd. bucket. A 1⅜-in. track cable passes over a tower 122 ft. high and has one end anchored to a deadman in the pit, while the other end (beyond the tower) is attached by a follower tackle and blocks to an anchorage cable leading to another deadman.

Operating the Dragline Excavator

A traction cable hauls the bucket at a speed of 250 ft. per min. while excavating and 600 ft. per min. while running from the pit to the top of the tower. For raising and lowering the bucket, the sag of the track cable is changed by means of the follower tackle. The two

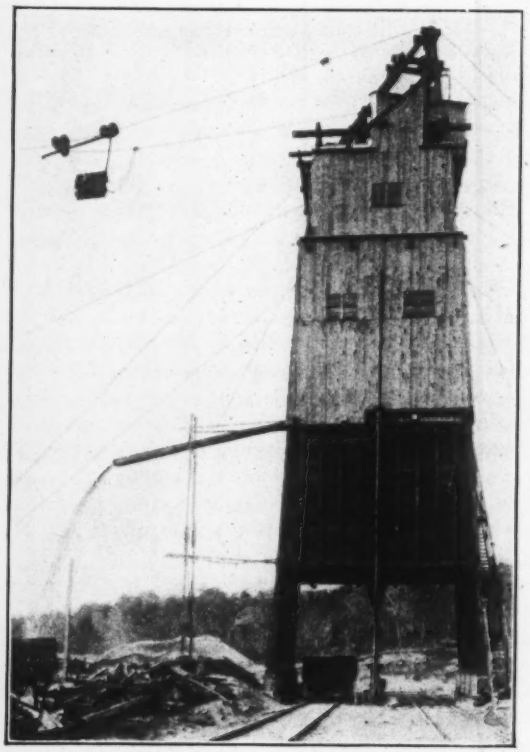


FIG. 1. SAND AND GRAVEL WASHING PLANT WITH DRAGLINE BUCKET EXCAVATOR

operations of raising and lowering the bucket and hauling it to and fro are accomplished by two drums in the tower—a two-speed drum for the traction cable and a one-speed drum for the follower. These are driven by a 75-hp. slip-ring electric motor. A 5-hp. motor in the tower drives an air compressor of the type used on electric cars, the air operating the pneumatic friction control of the traction-cable drums.

The bucket is suspended from the cable by two double sheaves running on the main cable. The forward one

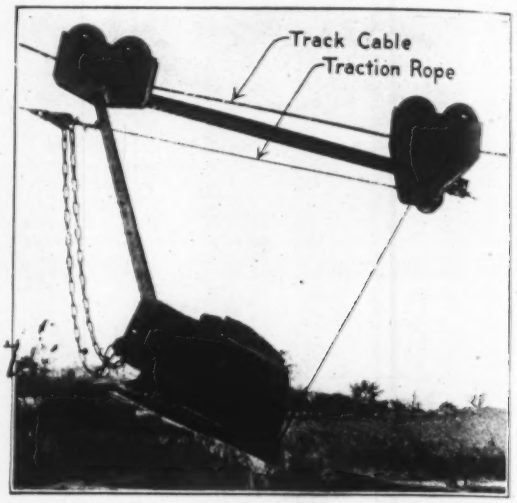


FIG. 2. DRAGLINE BUCKET, SHOWING TROLLEYS AND CABLE CONNECTIONS

is attached to the bail of the bucket and also to the end of a 6-ft. I-beam which passes through (but is not attached to) the rear sheave (Fig. 2). When the empty bucket is returning by gravity from the tower, these sheaves are at the opposite ends of the I-beam, and the bucket is balanced so as to be in digging position as it travels back to the excavation. During the digging process the pull is on the bridle chains attached at the front corners of the bucket.

When the loaded bucket is being pulled back to the tower, the strain is on an extension of the traction cable which passes over a small idler sheave in the rear sheave and is attached to the back of the bucket. As it reaches the tower, the front sheaves come in contact with a stop on the supporting cable and further pulling on the traction cable raises the back end of the bucket and thus accomplishes the dumping. This device requires no latches, and the dumping is effected automatically and rapidly. The average rate of operation is 45 round trips of the bucket per hour.

Screening and Washing the Material

The arrangement of the screens and bins is shown in Fig. 3. The gravel dumped into the hopper passes over a grizzly, or bar screen, which permits all material of less than 2-in. size to pass through onto the top one of four nearly horizontal shaking screens, as shown. The sizes of the round holes in the screens are such as to separate the materials into the following sizes: 2- to ⅜-in. for mass concrete, 1- to ⅜-in. for reinforced concrete, ⅜- to $\frac{3}{16}$-in. for roofing gravel, $\frac{3}{16}$- to ⅛-in. for granolithic sand, and everything below ⅛-in. for building sand.

The oversize material runs over the grizzly bars into a hopper and thence to a crusher, after passing which it is delivered to the top deck of the horizontal screens. Any material that does not pass through the top screen

*Consulting Engineer, 6 Beacon St., Boston, Mass., and Professor of Railroad Engineering at the Massachusetts Institute of Technology.

(being over 2-in. size) passes off at the lower end of the screen into a chute feeding a bucket elevator which dumps it again into the crusher hopper.

When the material falls on the top screen, it is deluged with water delivered by a 25-hp. centrifugal pump running at 1,800 r.p.m. and delivering 1,000 gal. per min. The water passes through all four screens, thoroughly washing the materials and carrying with it into the settling tank everything less than ⅛ in. in size. A flight conveyor operates through this settling tank and pushes the sand forward to the high end of the tank, at the same time washing it and forcing it finally over the edge of the tank into the chute leading to the proper bin. The loam and other objectionable material pass off in suspension in the dirty water which flows over the lower end of the tank. The crusher, elevator, screens and flight conveyor are all operated by a 75-hp. electric motor.

The material retained on the various screens passes off their ends and falls into metal chutes which run to the proper storage bins below. In these chutes are tipples which permit of diverting the materials in such a manner as to make it possible to mix various sizes as

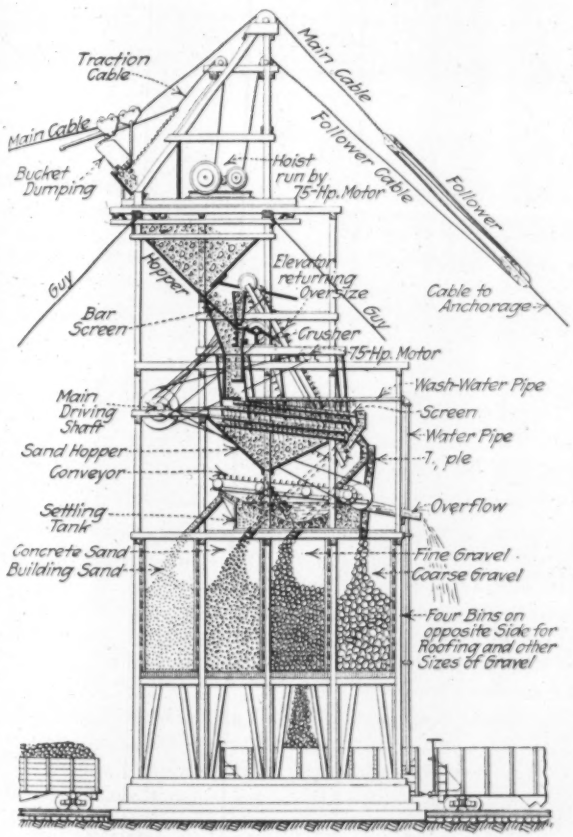


FIG. 3. SECTIONAL ELEVATION OF SAND AND GRAVEL WASHING PLANT AT LYNNFIELD, MASS.

they pass from the screens and so fill a bin with a mixture of sizes if required. Flush gates operated by hand levers allow the material in the bins to drop directly into railway cars beneath.

Excavation can be made as readily under water as in the dry, as the operator in the tower can tell from the load on the engine whether the bucket is being filled. As the excavation proceeds a trench is dug between points as near the deadman and the tower as seems safe, and to the full depth of the material. It is customary to bury a pair of deadmen about 150 ft. apart at the end of the track cable, and to attach the cable to one of these. Blocks and tackle are rigged from the cable to the other deadman, so that the line of the cable can be shifted about 75 ft. without shifting the anchorage on the other side of the tower or bringing excessive strain on the top of the tower.

This permits a wider trench to be excavated than would be possible if the main cable ran directly to one anchorage. When the trench has been excavated the two deadmen, one at each end of the cable, are moved, say, 150 ft. from their old position and a new cut is begun. The entire top of the tower above the hopper is built on a turntable, which is turned as the line of the cable is changed.

Storage and Shipping

The plant is operated by five men—one at the engine in the tower, one at the crusher, one at the screens and two repairing, cleaning and loading the cars.

In addition to the bin storage, provision has been made for ground storage of 100,000 tons of washed and graded materials. These materials are loaded on cars at the rate of 1,000 tons per day by means of a 15-ton steam-driven locomotive crane equipped with a 1-yd. clamshell bucket swung from a 50-ft. boom. The crane operates on standard-gage tracks and may be used when necessary for shifting the freight cars. The tracks, however, are on a grade so that the cars can be dropped by gravity under the bins, receive their load and pass along by gravity to the storage tracks beyond.

From this 122-ft. tower the cables can be stretched so as to permit excavation to be made at a distance of 1,300 ft., giving an available area of ½-mi. diameter before it becomes necessary to move the tower to another site. If the material is 20 ft. deep it will take 12 years of continuous operation before a plant of this capacity would have to be moved. The plant has a bin capacity of 1,300 tons and a daily production capacity of 1,000 tons. The material is a well-graded angular sand and a subangular glacial gravel; very little oversize material has been encountered.

This plant was designed by the Cable Excavator Co., of Philadelphia, Penn., and was built under the direct supervision of its Vice-President, A. D. Hadsel, who is also the inventor of the excavating bucket described. The plant is owned and operated by the New England Sand and Gravel Co., of West Peabody, Mass., the writer serving as consulting engineer for this company.

Progress of Second Simplon Tunnel—The latest report for the second Simplon Tunnel shows that the tunnel is over half-completed, the figures of completed tunnel at the end of October, 1915, being 29.9% for the south end and 25% for the north end, a total of 54.9%, according to the "Schweizerische Bauzeitung." The respective lengths are 19,431 ft. (5,924 m.) and 16,242 ft. (4,952 m.), a total of 35,673 ft. (10,876 m.). At each end four or five hundred feet more of top heading and excavation work has been done. The work accomplished during October amounted to 774 ft. (236 m.) of completed tunnel at the south end and 157 ft. (48 m.) at the north end, a total of 931 ft. (284 m.). This was accomplished with a working force in the tunnel of 628 and 90 for the two ends respectively, and outside the tunnel 212 and 79, making a total working force of 1,009. During recent months the work has been very seriously hampered by continual change of forces on account of the military draft of Italian laborers.

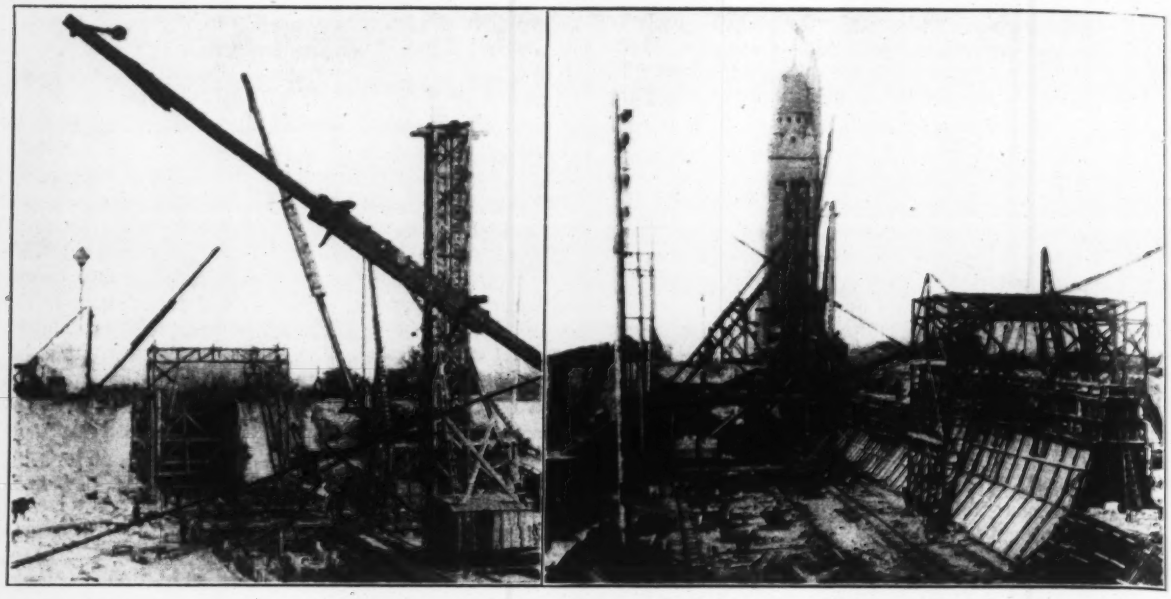


FIG. 1. CONSTRUCTION PLANT ON THE REPAIRS OF THE COMPTON HILL RESERVOIR AT ST. LOUIS

Reconstruction of a Reservoir at St. Louis, Missouri

SYNOPSIS—To check leakage from the earth-embankment reservoir at Compton Hill a new lining is being built and steel sheeting driven through the bank to rock. A new crosswall is also being built. In addition a wall will be built above the present top in order to allow of raising the water level. Concrete piles are used under the walls.

The Compton Hill reservoir at St. Louis has had considerable leakage. Within the past few years this has amounted to nearly 1,000,000 gal. daily. The loss of so much water after the expense incurred in pumping and purifying it has warranted the cost of extensive repairs to stop the leakage. No damage has been done by the escaping water, as it has been carried off by the sewers.

The reservoir is about 850x500 ft. in plan and 20 ft. deep, with a capacity of 65,000,000 gal. It is formed partly by excavation, but mainly by an embankment of stiff red clay, 20 ft. wide on top, with inner and outer slopes of 1½:1 and 2:1 respectively. A puddle wall in the bank was connected with the puddle floor. The slopes were paved with stone blocks on a layer of macadam, and the leakage was largely through this paving. A masonry crosswall divided the reservoir into two basins. This reservoir was completed in 1870.

The work now undertaken to stop the leakage includes the following: The lining of the old floor and slopes with reinforced concrete; the driving of a continuous line of steel sheeting from the top of the bank to rock; the construction of a concrete wall around the top on concrete piles and the steel sheeting; the removal of the old division wall and construction of a new concrete wall, having concrete piles and a cutoff wall extending to rock; the reconstruction of the gate chambers and erection of a new gatehouse.

In this new work the sides and the division wall will be carried up so that the water level can be raised about 10 ft., increasing the storage capacity by about 29,000,000 gal. The work is under the direction of Edward E. Wall, Water Commissioner; G. G. Black is engineer in charge of the Water Division, and F. R. Wiederholdt is Resident Engineer. The contractor is the Hiram Lloyd Construction Co., of St. Louis. The cost of the work will be about $280,000.

Construction of New Division Wall

The reservoir cannot be kept out of service for any great length of time, and the plan adopted was to rebuild the division wall at once, so that water can be stored in one basin while work is in progress on the other. The contract provided, therefore, that between Sept. 15 and Dec. 15 the contractor must reconstruct this wall and the gate chambers at each end, connect the slope and bottom paving of one basin with the wall and chambers, and make this basin sufficiently water-tight for immediate use.

The division wall, Fig. 5, is of reinforced concrete, 37 ft. high, 30 ft. wide on the base and 3 ft. at the top (4 ft. over coping). The batter decreases from 9⅜ in. in 12 in. at the lower portion to ½ in. in 12 in. at the top. Beneath the middle of the base is a 36-in. cutoff wall extending to rock at a depth of about 15 ft. This cutoff wall also extends under the gate chambers. Under each side of its base are two rows of concrete piles driven to rock. The rows are 4 ft. c. to c. and the piles in each row 3 ft. c. to c., not staggered. The construction of the foundation of the wall is shown in Fig. 3.

There are four expansion joints extending the full depth of the wall. These are spaced 129 ft. apart, the

two end joints being at the connection with the walls of the gate chambers. They are of the tongue-and-groove type, as shown, and the filling is built up of alternate layers of felt and asphalt to a thickness of ¾ in. The ends of the walls at these joints have extra vertical reinforcing bars, also horizontal bars bent to fit the tongue and groove.

The concrete is a 1:2½:5 mix, made with crushed limestone or Meramec River gravel of ¼- to 2-in. size, and sand passing a ¼-in. screen. This proportion gives 1 sack of cement to 6 cu.ft. of concrete. No crusher-run stone is permitted. The steel reinforcement consists of round rods. All wires or metal ties for securing the forms must be cut off at least ½ in. from the face of the wall and the holes filled with 1:2 cement mortar. A certain amount of the old stone blocks is allowed to be placed in the new concrete as pudding stone or plums. The remainder is crushed by a crusher erected on the floor of the reservoir for use as concrete aggregate, the contractor disposing of the screenings for street or other work. The old wall contained about 6,000 yd. of masonry, and the new one will have about 10,000 yd. of concrete.

Reinforcing the Sides of the Reservoir

The interior slopes of 1½ on 1 have a paving of 16-in. stone blocks laid on 6 in. of macadam and grouted with cement. This paving will be thoroughly cleaned and covered with 3 in. of concrete, upon which will be a waterproofing course composed of six layers of asphalt and five of felt. Upon this will be a 3-in. concrete covering, reinforced with wire netting and laid in slabs 8 ft. wide, with a horizontal joint along the middle of the slope. In order to thoroughly bond the first layer of concrete with the stone paving, some of the paving blocks will be removed (one for each 64 sq.ft. of surface), the concrete being filled into the opening to form a key, or anchor.

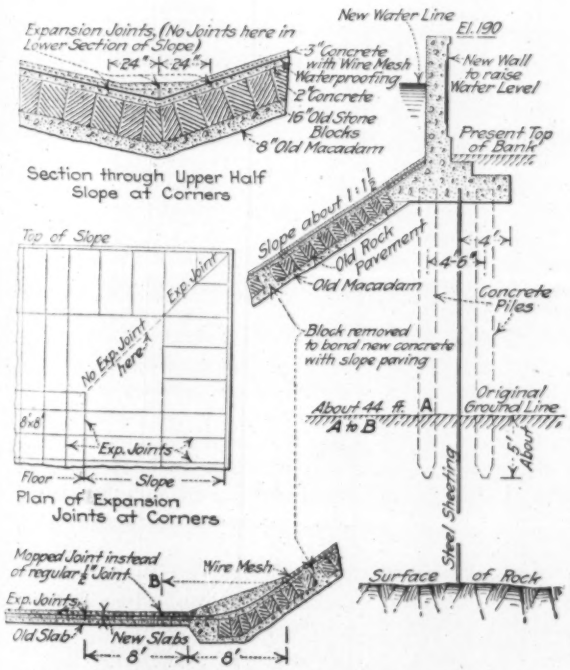


FIG. 2. SLOPE LINING AND REINFORCEMENT OF COMPTON HILL RESERVOIR

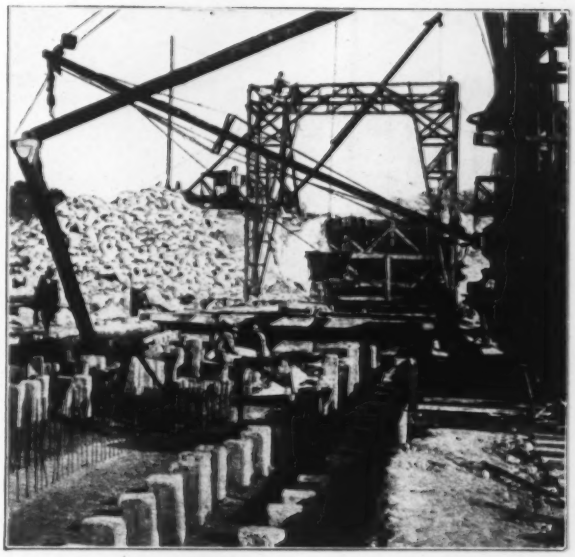


FIG. 3. CONCRETE PILES AND STEEL REINFORCEMENT FOR THE BASE OF DIVISION WALL

The four rows of concrete piles are under the footing, and the reinforcing rods project from the top of the cutoff wall which is carried down to rock. The rock pile at the left is for plums in the concrete. At the end of the wall the men are erecting the traveler for the forms. At the right is the traveling concrete plant, with boom to support the steel chutes

Fig. 2 shows a cross-section of the work and also the arrangement of expansion joints in the floor and slopes.

To prevent the escape of any water through the bank, a row of steel sheetpiling will be driven to rock, as shown. Borings were made at intervals of about 25 ft., showing minimum and maximum depths of 36 and 53 ft., the depth to rock being mainly about 40 to 45 ft. The sheeting is of the Lackawanna arch-web type, and will be driven by a steam hammer. To facilitate this work, the engineers at the site measured the piles and marked each with its length, so that they could be distributed around the reservoir according to the depths shown on the profile.

To enable the depth of water to be increased, a reinforced-concrete wall will be built around the inner edge of the bank, as shown in Figs. 2 and 4. This will be 18 in. thick, with a total height of 13 ft. (or 8 ft. above the footing). The top will be 4 ft. above the new water level. This wall will have a broad footing connected to the new slope paving and will be supported on two rows of concrete piles and the line of steel sheeting. The piles will be 3 ft. c. to c. in each row, staggered, and will be 24 ft. long, giving a penetration of about 5 ft. into the natural ground below the bank.

For this wall the concrete will be made with broken stone of ⅛- to 1-in. size. The mix will be about 1:2:4, giving 1 sack of cement to 4½ cu.ft. of concrete, while to increase the density hydrated lime will be added in the proportion of 10 lb. of lime for each sack of cement. The exterior of the wall will have a simple architectural treatment, as shown. The panels will be bush-hammered, while the remaining part of the exposed outer surface will be rubbed down with carborundum blocks and water.

In building this water-tight wall, 15-in. strips of No. 22 black sheet iron will be embedded in the concrete at all construction joints, to form effective water stops.

The original paving of the floor was of concrete slabs. These will be removed only where required to make room for the new division wall (Fig. 5). After the floor is cleaned of dirt and loose material it will be covered with two 3-in. courses of concrete in blocks or slabs about 8 ft. square, the joints of the upper course breaking joint with those of the lower. This is shown in Fig. 2. Between the two courses will be a waterproofing course similar to that on the slopes, except that pitch will be used instead of asphalt.

The gatehouse will be a concrete building 48x25 ft., over the south gate chamber. Here there will be orna-

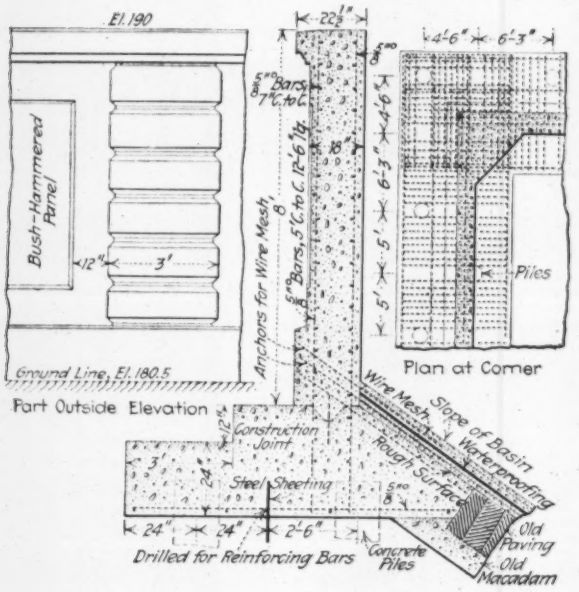


FIG. 4. NEW RETAINING WALL ON TOP OF RESERVOIR
This is bonded to the slope lining and the new water level will be 4 ft. below top of wall

mental stairways, a fountain and other features of architectural treatment. Much of this work will be of cast concrete blocks, the concrete being made with stone of ⅛- to 1-in. size (but without sand) in proportions of 1:3½ to 1:5. It is reinforced to give sufficient strength for handling and to prevent cracking. The building and decorative features were designed by Roth & Study, architects, of St. Louis.

Reinforced-Concrete Piles Used

The specifications permitted the use of concrete piles either straight or tapered and of any form of cross-section, provided that the surface area should be not less than that of a cylindrical pile 15 in. diameter. The contractor preferred to use straight piles, 12½ in. square, with 1-in. chamfer on the corners. The point tapers in 12 in. to 8x8 in. at the end.

The concrete is a 1:4½ mix, made with gravel of ¼- to 1-in. size, except that at the ends it is 1:3½. The reinforcement consists of six ⅝-in. bars, having the ends bent inward. These are bound by hoops ¼x1 in. about 4 ft. apart, and wrapped spirally with No. 10 wire having a pitch of 4 in., reduced to 1 in. for 18 in. at each end. The bars are wired to the hoops and spiral. They are 1 ft. shorter than the pile, and no reinforcement must come within 6 in. of the head of the pile. These piles will be driven by steam hammers, cushion caps being placed on the heads of the piles.

The concrete piles are made in a yard at the foot of the bank of the reservoir. At one end is a ½-yd. concrete mixer, from which the concrete is delivered to the pile forms by wheelbarrows. Then comes a platform on which the piles are cast and which is long enough for seven rows of 23-ft. piles, with ten in each row. At the other end of the yard is the storage space, where the piles are stacked horizontally while curing.

The platform is heavily built and carefully leveled, so that the piles can be cast directly upon it, and only side forms are required. These are of wood and are used several times. An iron cap, however, is used for the point. The bending of the bars is done by hand. For placing the hoops and wire wrapping, the six bars are fitted to two disks on a long pipe supported on horses and turned by a crank handle at one end. This plant can make 40 piles per day.

The piles remain in the forms for 24 hr. (48 hr. was allowed at first) and are then picked up and removed to the storage stacks by a traveling gantry which spans the yard. This gantry consists of an I-beam of 32-ft. span supported at the ends on timber A-frames 16 ft. high, each mounted on two wheels. On the I-beam runs a trolley hoist carrying a swing beam having chain slings. This gantry is moved by hand. The piles are held at least 30 days for curing and are sprinkled twice daily.

Construction Plant and Methods

The first part of the work, as noted already, was the reconstruction of the division wall and the gate chambers at its ends. This work had to be done rapidly, as explained.

The old stone masonry was drilled by hand, 6-ft. holes being put down by "jumping" long drill rods. Light charges were fired at the end of each shift. The masonry thus thrown down upon the floor was removed in various ways—by a small flat-car on an industrial railway, by stone boats with teams, by chains handled by teams or derricks, and especially by the use of two light steam shovels. These shovels also rooted up the old concrete footing.

Part of the stone was piled for use as plums in the new concrete wall, and part of it was hauled by stone-boats and dump wagons to a stockpile adjacent to a crusher and screening plant erected on the floor of the west basin, in connection with the concreting plant. The earth and rubbish were hauled away in dump carts and used for filling vacant lots owned by the contractor within a few blocks of the reservoir. Screenings from the stone crusher were removed in the same way and used for filling or sold for street-repair work.

For bringing in supplies and hauling away material, two inclined roadways of 12% grade, supported on timber trestling, were built from oposite sides of the bank down to the floor of the reservoir. Loaded wagons were assisted up the inclines by snatch teams or by a cable from a hoisting engine. Concrete material was dumped through openings in the inclined roadways, falling into bins beneath.

For removing the old wall and handling the stone plums of the new wall there are two stiff-leg derricks, mounted on rectangular towers and having 40-ft. masts and 85-ft. booms. They travel on a wide-gage track laid parallel with the wall and are propelled by power. Between the derricks and upon the same track is the traveling

concreting plant, on a platform 14x24 ft. This carries a 3½-yd. mixer and 70-ft. elevator tower, with bucket supplying the gravity chutes. It travels the full length of the wall in about three hours. Wood forms are used, built in sections and handled by a traveler spanning the wall.

Two general views of the work are shown in Fig. 1. The view at the left shows the concreting plant and tower with one of the traveling derricks beyond it. The derrick at the left, on top of the bank, is erecting the traveler for the forms. In the other view there is one of the inclined roadways at the left, and in front of the water

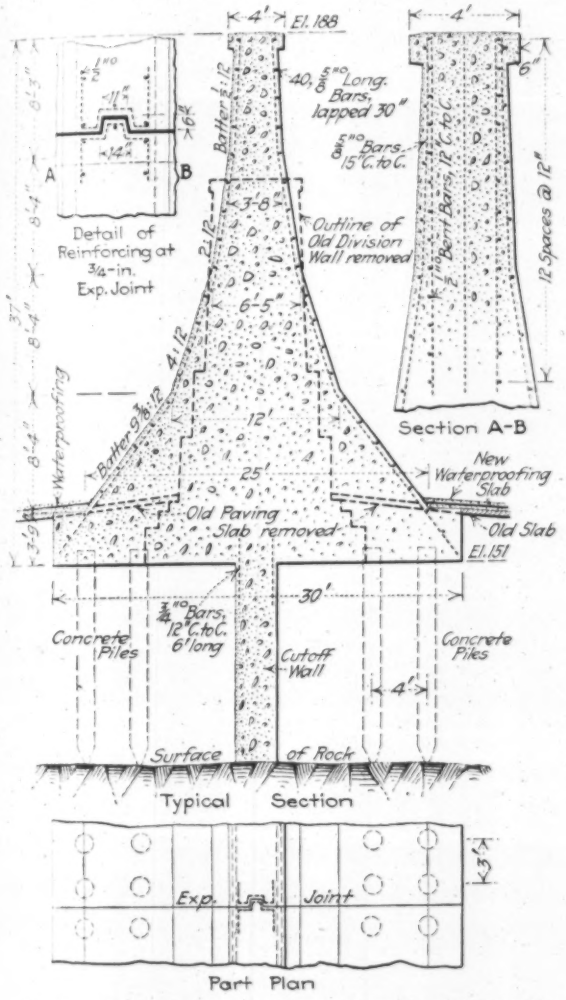


FIG. 5. DIVISION WALL, COMPTON HILL RESERVOIR

tower is the concreting tower and a derrick. At the right is the wall under construction.

The work is carried on by night and day, in two 10-hr. shifts, except that the carpenters work 8-hr. shifts. For the night work there are eight 500-watt tungsten lamps on a wire stretched over the reservoir. These give an excellent light, but during the blasting the lamps were frequently shot out.

The Bergen Turnpike, said to be the last toll road in New Jersey, has been purchased by the Bergen County Board of Freeholders. The turnpike has been owned by the Public Service Corporation, which operates a street railway on the turnpike. It extends from Hackensack to the Hudson County line. Tolls have been collected at four toll gates since 1802, and ever since then Bergen County farmers have had to use this thoroughfare across the Jersey meadows to reach the New York City markets.

A Survey Yarn from Kansas

By A. G. Barnett, Jr.*

Paul Bunyan, who worked as County Surveyor out in Kansas, had some reputation in his profession. The following is an account of a job he did for Silas Emery. Silas himself told the story to a party of Rock Island engineers who had taken refuge in his toolshed from one of the Sunflower State's justly famous summer showers.

"I hired Paul," said Silas, "to run out my north line because my neighbor was aimin' to string a fence on what I knowed was my land. They had been a stone set twenty rod notheast o' my cow barn when the widder Smith owned the layout, but seemed as if I couldn't rightly locate the durn thing. But Paul, he had the guvment notes fer the whole county and the one west, so I knowed he could fix me up proper.

"Well, out him and his long-laigged boys come one mornin' at sun up and set out to find a monnyment to start out from, but they didn't find none till they come to the second range line east; but that there was a buffalo horn set seven inches down in gravel at the aidge of a crick, as the notes called for, so Paul he felt safe to start and they lit out. They'd chain out eighty rod after the compass was set level and the proper deeclination set off, and then Paul would pull up his instument and go whar the boys had got to and start em off agin. And then this-away, bein' right pert steppers, they seevayed them seven miles in two hours, and come to where my corner was supposed to be at. I recollect Paul he was lookin' mighty cocky when he come up to whar the last pin was stickin' in the ground.

"'Thar she be,' he sings out, 'jest six inches underground, and if you'll shove down on that there pin you can find her yourself.' Wa'll, I goes over and shoves her in clean up to the red flannel but nary stone did I tetch ner feel.

"Now Paul havin' the name he had for doing tiptop work I felt right disappointed thinkin' of him amissin' that stone, and I reckon I showed my feelin's some too. Paul, he wasn't lookin' so cocky no more neither. Never did I see a feller more put out. He reads all his guvment notes over time and agin, and him and the boys they puts down a whole raft of figgers and takes turns a addin' them up.

"Then Paul gits up and takes their sightin' pole and rams her down where the pin was settin'. Full two foot he druv that there pole down 'fore he give it up as a bad job, and set down and went to pawin' over that old yaller note book agin. 'Fore he set down, though, he allowed as how he'd give up and take to ranchin'.

"Finally I heered him snickerin' and I looked over to whar he was, and thar he set grinnin' fit to kill. 'Come here, Si,' sez he, 'and read the discripshun of this here monnyment.' Seems he had overlooked readin' that there discripshun all this time cause of it bein' over on the right-hand page with figgerin' all 'round and runnin' into it. But thar it set, writ plain enough for anybody once you noticed it. 'For the notheast corner of section 14, havin' run out of buffalo horns, I set an old grindstone purloined from the widder Smith's shed, six inches below the surface of the ground.'

"Yep, the pole Paul hed shoved down two foot was stickin' plumb through that there corner."

*Madison, Wis.

Continuous Wire Winding for Wood-Stave Pipe

A new type of wood-stave pipe has recently been developed in California and has been used in building two conduits of considerable length. Engineers everywhere are familiar with the continuous wood-stave pipe in which the staves are secured by round steel hoops meeting at a joint piece and secured by nuts. Smaller sizes of wood pipe have long been on the market in which the exterior of the pipe is wrapped with a spiral wire winding, the pipe being made up in convenient lengths with the wire winding secured at the end. In laying pipe of this latter class, joints have to be made of course between the successive lengths of pipe.

The new type of pipe is a continuous stave pipe wrapped with a continuous helical winding of wire. The wire is wound on the pipe after it is laid in place by a machine, illustrated in the accompanying cut, which winds the wire with a uniform tension and uniform pitch, both the tension and the pitch being adjustable according to the size of the pipe and the water pressure which it is to sustain.

The machine is a simple and rugged affair, and has a gear wheel which encircles the pipe and is driven through speed-reduction gearing by a small compressed-air motor. As this gear wheel is rotated around the pipe it is at the same time given a longitudinal motion along it. This rotating gear wheel carries rollers between which passes the wire to be wound on the pipe, and these rollers are adjustable to give the wire the desired tension. The wire is unwound from a reel that encircles the pipe ahead of the machine.

When a new reel of wire has to be put on, the ends of the wires are welded together by a miniature electric welder furnished with the apparatus. After the electric welding, the joint is regalvanized. The necessity for the electric-welded joint arises from the fact that in order to pass through the machine with even tension the wire must be of uniform diameter and flexibility, a result which could not be obtained with the telegraph lineman's splice.

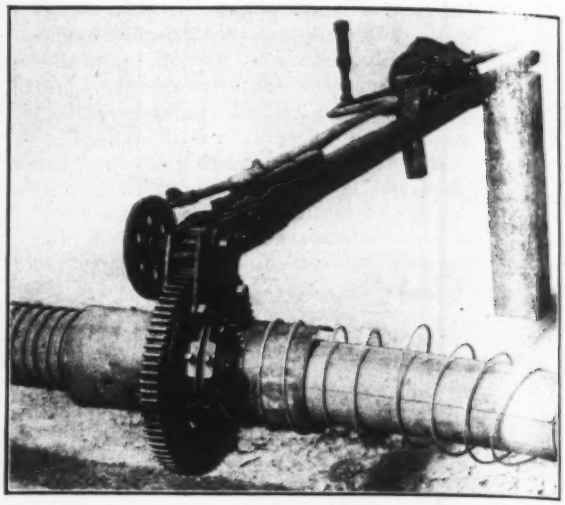


FIG. 1. MACHINE FOR APPLYING A CONTINUOUS SPIRAL WIRE WINDING TO WOOD-STAVE PIPE

After the wire is wound on the pipe and before it is lowered into the trench, the entire pipe with the wire winding is given a heavy coating of asphalt. Fig. 3 illustrates the method of applying the asphalt. A sleeve slightly larger than the pipe has elastic and flexible ends made of fabric which fits snugly over the pipe. By means of a funnel on top, this sleeve may be filled with hot asphalt. It is then drawn slowly along the pipe. It is claimed that by using galvanized wire and heavily coating the pipe with asphalt a long life for the pipe is assured.

The first pipe of this type was laid about four years ago by the Standard Oil Co., of California, near Bakersfield, to furnish a water-supply to a refinery. The pipe is 18 in. in diameter, about 2,400 ft. in length, and carries a maximum head of 60 ft. Recently a longer pipe has been laid for the California Pine Box and Lumber Co., at Delleker, Calif. This line is 6,500 ft. long, of 10-in. diameter, and is under a maximum head of 200

FIG. 2. LAYING A CONTINUOUS WIRE-WOUND WOOD-STAVE PIPE LINE

FIG. 3. APPLYING ASPHALTUM AFTER LAYING

Flexible hose conveys compressed air from a portable compressing outfit to the motor which drives the wire-winding machine. The portable electric welder for joining the lengths of wire is seen at the right of the left-hand view

ft. About 180,000 ft. of No. 4 galvanized wire was used on this line, and 120 welds were made. The spacing of the wire was from $1\frac{1}{16}$ to $2\frac{7}{16}$ in., according to the head on the pipe. The line was laid through very rough country, and some curves as sharp as 30 deg. were made. The pipe was laid at the rate of about 450 ft. per day.

An important advantage claimed for this pipe is its low cost, especially for pipe lines of small diameter. In comparison with wood-stave pipe made up in lengths, the entire expense of the joints is saved; and further, the staves for the pipe can be shipped at much less cost than the made-up lengths of pipe. The pipe can be bent to sharp curves as it is built up, and a great deal of expense in carrying a pipe line through rough country is saved by adapting the pipe line to the contour of the ground.

Ordinary wire of 60,000-lb. tensile strength is used, and wire of various diameters can be used according to the size of the pipe and the pressure it is to carry.

This new method of constructing wood-stave pipe is controlled by the Continuous Wire Wound Pipe Co., Room 1216, Flood Building, San Francisco, Calif.

Engineering-Education Faults

By W. M. Wilson*

Engineers feel that they are not receiving the recognition they deserve. Engineering as a profession apparently does not stand as high in the eyes of the public as do the law and medical professions. Public affairs are in the hands of lawyers, doctors and business men. Commissions, even when called upon to consider questions involving engineering problems, are seldom controlled by engineers.

Although engineers may feel that they are not getting a square deal, as evidenced by the discussions in the engineering periodicals, it is well to remember that men are appointed to commissions, not because they are doctors, lawyers, business men or engineers, but because they have seen the need of society for this thing for which the commission stands, because they are men of ability and reputation and are willing to sacrifice their time and money for the public welfare, qualities which are essential in one who would serve on a public commission.

Are Engineers at Fault?

In view of this fact, does it not seem that the fault may be with the engineer rather than with the public or the ones in power? Since engineering education, as distinguished from other kinds of education, has been in vogue about half a century, if engineers are failing to meet the standards of a learned profession, may not the fault be in their professional training?

Engineering has been defined as the utilization of the resources of nature for the benefit of mankind. In considering the education of an engineer it is this comprehensive view of his work which the writer has in mind rather than the more popular view that an engineer is a person who surveys a railroad, designs a generator, runs an engine or does any other one thing which requires a highly specialized technical training. It is the failure to understand the function of an engineer that is responsible for so many poorly planned courses of study in our schools and that is also responsible for men being classified as poorly paid engineers who are really well-paid mechanics.

University courses of study have changed rapidly. During the early part of the last century they included only the study of pure science, philosophy and literature. About the middle of the century a few schools introduced courses in applied sciences. These met with but little encouragement at first, but finally grew in popularity, until near the close of the century a huge wave of popular engineering education flooded the country. Though this, on the whole, was a good thing, it carried with it some undesirable features. Chief among these was an irresistible demand for what were spoken of with pride as practical courses. It seemed to be the prevailing opinion that in some mysterious manner a student could attain a greater proficiency in certain highly specialized mechanical processes after a few hours' practice each week for a few months than a mechanic could acquire working day after day for years.

Although trade-school training is recognized as valuable to a man who expects to spend his life as a mechanic, the better engineering schools soon realized that such work could not take the place of scientific training for the man who expected to be, not a technical expert, but an engineer in the broader sense of the word. Manual training has therefore lost its standing as a part of a university course of study, and though shop work is still given in most first-class engineering schools, it is used more to illustrate the principles of scientific shop management than to train expert mechanics.

Over-specialization a Menace

Although the danger from over-emphasis of manual training has been largely done away with, the engineering schools of today are facing in over-specialization an even more serious menace. All engineering work was originally classed as either military or civil engineering. Civil engineering was later divided into four major divisions, known as civil, mechanical, electrical and mining engineering. At the present time some of our schools, at least, are apparently vying with one another in their endeavor to subdivide each of these major divisions into the largest number of attractively named subdivisions. Some of the schools frankly admit that this is done for advertising purposes. Manufacturers, however, recognize that any advertising scheme that injures the product is poor business policy.

Schools which recognized the folly of trying to train expert mechanics are, nevertheless, now trying to do for office work what a few years ago they tried to do for shop work. A man who does the technical work in a specialized line of engineering uses certain scientific facts over and over, day after day, and becomes expert at his particular process just as a mechanic does. In a sense he is a mechanic. Although a higher order of mentality is required, it is a difference in degree rather than in kind. Given sufficient training, it is something that almost any one can do. It would seem, therefore, as illogical for universities to train expert draftsmen and calculators as it is admitted to be for them to train expert mechanics.

It is true that special training in college will help a draftsman or a calculator just as a trade school will help

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